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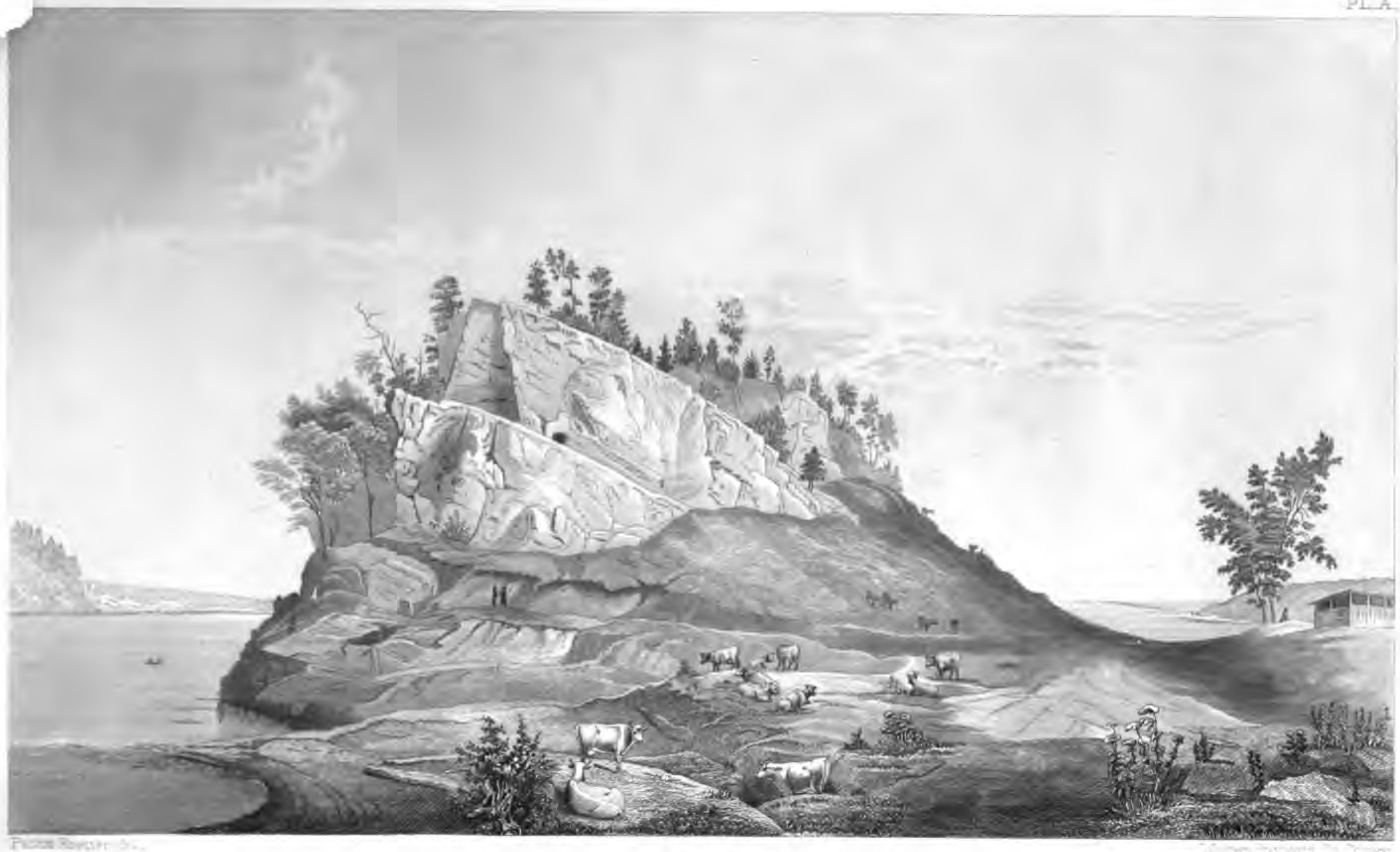

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"DEVIL'S BAKE OVEN" JACKSON CO.

# GEOLOGICAL SURVEY OF ILLINOIS.

A. H. WORTHEN, DIRECTOR.

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## VOLUME III.

# GEOLOGY AND PALÆONTOLOGY.

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## GEOLOGY,

BY A. H. WORTHEN,

AND ASSISTANTS
HENRY ENGELMANN, H. C. FREEMAN, H. M. BANNISTER.

## PALÆONTOLOGY,

BY F. B. MEEK AND A. H. WORTHEN.

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TO HIS EXCELLENCY

THE HON. RICHARD J. OGLESBY,

GOVERNOR OF THE STATE OF ILLINOIS.

GEOLOGICAL ROOMS,
SPRINGFIELD, *January*, 1868.

SIR: I have the honor of submitting, for publication, the Third Volume of my Report on the Geological Survey of Illinois, in accordance with the provisions of the third section of an act passed by the twenty-fifth General Assembly and approved February 28, 1867, entitled "An act to increase the efficiency of the Geological and Mineralogical Survey of Illinois;" which section reads as follows:

> "SECTION 3. That the publication of three thousand copies of the third volume of the Report of the State Geologist is hereby authorized; and the sum of five thousand dollars, in addition to the unexpended balance made for the publication of the two preceding volumes, is hereby appropriated, to defray the cost of engraving, and such incidental expenses as may occur—to be expended under the direction and by the approval of the Governor and State Geologist. And the Secretary of State is hereby required to procure the paper necessary for the said third volume, through the state contractor, of a quality not inferior to that used in the preceding volumes; and the amount necessary to defray the cost of the same is hereby appropriated."

As soon as possible, after the passage of this law, a contract was made with "The Western Engraving Company of Chicago" for the necessary engravings, which are now so nearly completed, that the printing need not any longer be delayed.

I have the honor to be,
Your obedient servant,
A. H. WORTHEN.

# CHAPTER I.

## COAL MEASURES AND LOWER CARBONIFEROUS LIMESTONES.

The Carboniferous system of Illinois, including the Coal Measures, the Conglomerate and the lower, or Sub-carboniferous limestones, attains a maximum thickness of at least 2500 feet, and underlies about three-quarters of the whole area of the State; and whether we consider it in reference to its stratigraphical thickness, its geographical extent, or the value of the products derived from its mines and quarries, it ranks first in importance among the geological systems developed within our borders. Consequently it is from this system, mainly, that our great mining interests are to be developed, and every new fact observed, which tends to a more complete understanding of the amount and accessibility of the bituminous coals, fire and potter's clays, iron ores, etc., of the Coal Measures, or the galena, the fluor-spar, and the various building stones and limestones of the lower Carboniferous series, is important, as tending to facilitate our mining operations, increase the annual products of our mines, and promote the industrial interests of our people.

In the prosecution of the field work of the survey during the past season, special attention was given to the determination of the number, thickness and relative position of our valuable coals, and we are now able to present a correct vertical section of the Coal Measures, as they are developed in the central and northern portions of the State, and to correct some errors we were led into, in the first volume, in attempting to fix a parallelism between our coals and those of Kentucky, as represented in the Kentucky section. On taking charge of the Illinois survey, I thought it important, inasmuch as our coal field was known to be the northern extension of the Kentucky basin, to establish, if possible, a parallelism between the coals of Illinois and those of Kentucky, as they were represented in the published sections of the Kentucky Reports, in regard to the correctness of which we had entertained no doubt, as they had been constructed under the supervision of that eminent geologist, the late Dr. D. D. OWEN, whose reputation as a reliable practical geologist was second to no man's in the west. With this object in view, I secured the services of Prof. LEO LESQUEREUX, who had been employed in Kentucky and was consequently familiar with the coals of that State; and, together, we visited, during the summer of 1860, the principal coal mines worked at that time in our State, examined the coals, making careful sections of the beds with which they were associated, and collected the fossils characteristic of the different groups, and the result of our observations was given in the first volume of the Report. Subsequently we became satisfied that some of the conclusions to which we had been led in regard to the position of some of our coal beds were erroneous, and we were finally compelled to believe, from further investigations, that the Kentucky section was incorrect; or else no parallelism could be made out between the workable coals of the two States. For example, the *Aviculo-pecten rectilateraria,* (Cox's sp.), with the associated fossils, which in Kentucky was regarded as characteristic of their coal No. 9, was found in Illinois in a much lower position, and characterizing a coal here, which was not higher in the series than coals No. 3 or 4 of their sections; and furthermore, we became satisfied that all the workable coals in Illinois were restricted to the lower part of the measures, and that we had no coals, except some thin beds of no practical value, that occupied as high a position in the series as Nos. 9 and 11 of the Kentucky section.

In order to fully determine the question as to the true position of the Illinois coals, a section was made by myself and

Prof. LESQUEREUX during the early part of the past summer, along the valley of the Illinois river, commencing in Schuyler county, where the lower portion of the Coal Measures rests upon the Lower Carboniferous limestone, and extending to LaSalle, where the measures are suddenly intersected by an upheaval of Silurian strata. The Illinois runs diagonally across the Coal Measures in this portion of the State for a distance of more than a hundred miles by the course of the stream, which is from N. E. to S. W., and intersects all the measures occurring in the central and northern portions of the State. This section gives us 10 seams of coal in a vertical thickness of about six hundred feet, all of which have been identified in the immediate vicinity of the Illinois river, except No. 4, which was seen only at Effnour's mine, near Cuba, in Fulton county, and is probably only a local development. Six of these seams average from 2½ to 6 feet in thickness, while the others range from 2 feet down to a few inches. We have numbered them consecutively from the base of the section upward, and it will be seen at a glance, by referring to the section, that all the workable coals belong to the lower division of the measures, and are inclosed in the lower three hundred feet of strata. We have seen no coal in the State more than two feet in thickness that appears to belong above the horizon of coal No. 6 of this section, and all the thicker beds that have come under our observation in those portions of the State already examined, can be readily referred to some one of those represented in the lower division of the following section. The various shafts sunk in the upper measures during the past year have given us much information, obtainable in no other way, in regard to the distribution of the coal in the central and northern portions of the State; but as these shafts have been carried no deeper than was necessary to reach coals No. 6, or 5 where that was wanting, we know, as yet, nothing in relation to the extent to which the lower seams are developed at points remote from their outcrop. The lower seam, however, or No. 1 of the following section, has not yet been identified along the northern borders of the coal field, and No. 2 appears to have taken its place in that portion of the State. A boring of 250 feet below No. 5, or the Howlett seam, would settle the question as to the development of all the lower seams at any given point; but as they are usually somewhat thinner than the higher seams, but little effort will probably be made towards their exploration until the thicker seams are exhausted at some distant future period. There is no good reason to suppose that the coals below No. 5 will not be found in the centre of the coal field, and they might even attain there a greater thickness than they usually present on the borders of the field; and this would be strictly in accordance with what might be expected in tracing a bed of coal from the borders towards the centre of the basin. And as the distance from the surface to these lower seams in central Illinois, is much less than the depth at which coal is now successfully mined in other countries, the time must come, unless the discoveries of science should give us some cheaper substitute for coal, when all the seams in the Illinois basin will be opened up, and their rich deposits made available, even to the depth of a thousand feet or more below the surface.

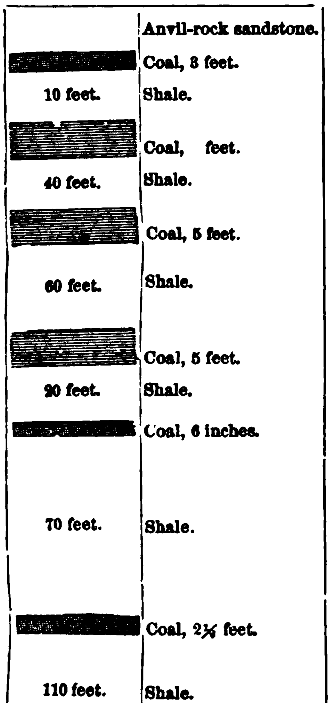
The lower part of the following section has been constructed from continuous outcrops of the lower coals, and the beds with which they are associated, in the valley of the Illinois river, and the upper part from the outcrops in the vicinity of LaSalle, and from the shafts at that point and in the vicinity of Springfield. The measures become thinner and more calcareous towards the northern borders of the coal field, and consequently the limestones are more numerous and relatively somewhat thicker, as they are represented in this section, than they will prove to be in the central and southern portion of the State, especially in that part of the section above the workable coals.

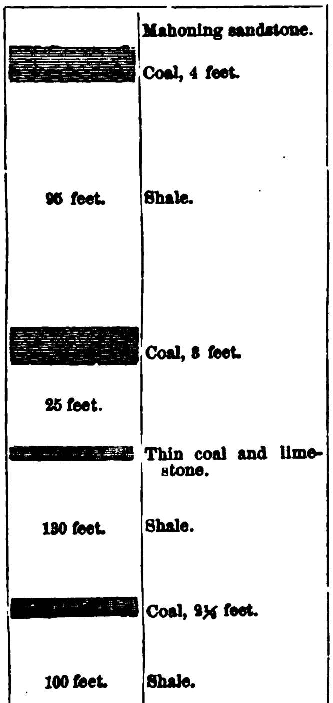
*Section of the Coal Measures in Central and Northern Illinois.*

| | |
|---|---|
| 22 feet. | Blue, red and gray shales, with a band of calcareous nodules near the top, about two feet in thickness. |
| 3 feet. | Limestone and calcareous shale, with fossils. |
| ≡ | Bituminous shale and thin coal No. 10. |
| 35 feet. | Red and blue shales, with a calcareous red band near the base, containing *Productus Nebrascensis*, *Spirifer cameratus*, *Athyris subtilita*, etc. |
| 14 feet. | Gray limestone in regular beds, containing *Pinna peracuta*, *Spirifer cameratus*, *Productus Nebrascensis*, *P. punctatus*, *Petalodus destructor*, *Phillipsia*, *sp.*, *Deltodus angularis*, *Sandalodus carbonarius*, *Poteriocrinus ? hemisphericus*, etc. |
| 10 feet. | Calcareo-argillaceous shales, with the same fossils as the limestone above. |
| 12 feet. | Unevenly bedded and nodular argillaceous limestone, with partings of clay-shale, containing, in great numbers, *Athyris subtilita* and *Productus longispinus*. |
| 6 feet. | Blue clay shales, with *Myalina recurvirostris*. |
| ≡ | Thin coal No. 9. |
| 20 feet. | Clay shale, with thin band of limestone. |
| 3½ feet. | Limestone. |
| ≡ | Thin coal No. 8. |
| 62 feet. | Blue clay shales, with two or three thin bands of limestone, including a thin bed of bituminous shale near the base. |
| 4 feet. | Gray limestone, sometimes underlaid or replaced by a thin coal No. 7. |
| ≡ | |
| 19½ feet. | Blue, red and brown shales. |
| 48 feet. | Sandstone and sandy shales, passing into a slaty shale at the bottom. |
| 6 feet. | Bituminous shale and brown and gray limestone; the latter with calcareous shales often attaining a thickness of fifteen to twenty feet, with the characteristic fossils of the Belleville coal. |
| ■ | Coal No. 6. |
| 3 feet. | Fire clay, passing into a nodular argillaceous limestone, with fossils, among which are *Chætetes milleporaceus*, *Bellerophon nodocarinatus*, etc. |

| | |
|---|---|
| 85 feet. | Sandstone and sandy or argillaceous shales. |
| 2 feet. | Hard bituminous limestone. |
| | Black shale, with *Discina nitida*, *Lingula umbonata* and *Cardinia? fragilis*. |
| ■ | Coal No. 5. |
| 3 feet. | Fire clay, sometimes passing into an argillaceous limestone. |
| 20 feet. | Shale and sandstone. |
| ■ | Coal No. 4, (a local seam, probably.) |
| 80 to 100 feet. | Sandstone and sandy shale, with a band of dark blue or chocolate colored limestone at the base, containing *Cardiomorpha Missouriensis*, associated with small *Goniatites* and *Nautili*. |
| ■ | Coal No. 3. |
| 75 feet. | Sandstone and sandy shales, becoming argillaceous towards the bottom, and inclosing iron nodules with fossil plants, insects, fishes, *Crustacea*, etc. |
| ■ | Coal No. 2, sometimes divided by a clay parting. |
| 80 feet. | Shale and sandstone, passing down into a hard, black slate, forming the roof of the coal. |
| ■ | Coal No. 1. |
| | Fire clay, resting on the Mill-stone grit, or the lower limestones. |

By comparing the foregoing with the Kentucky section, we shall find that there are no beds in Illinois that can be referred to those in that section intervening between the Mahoning and Anvil-rock sandstones, and no sandstone associated with our upper coals that can properly be considered as the equivalent of the upper sandstone of their section, unless it is that over our coal No. 6. Hence, we are inclined to believe that two different outcrops of the same bed of sandstone in Kentucky have been mistaken for distinct beds, occupying different stratigraphical positions, and by adopting this supposition they have increased the thickness of the measures 300 feet more than they really attain, and nearly doubled the number of their workable coals. That this is the true explanation of the want of parallelism between our section and theirs, seems highly probable from the general correspondence of the strata for 300 feet below these sandstones, as illustrated by the subjoined parallel sections of the strata as taken from the Kentucky section.





The lower portion of these two sections correspond almost exactly the one with the other, while in the upper part, the only variation consists in the intercalation of three beds of coal in the first hundred feet below the Anvil-rock, while there is but one in the same space below the Mahoning. But any one accustomed to working in the Coal Measures, will see at a glance the probable synchronism of the strata in these two sections, for sections could scarcely be made through equivalent beds at points 20 miles apart, anywhere in the measures, that would not show quite as marked a variation in the thickness and lithological characters of the strata, as are presented in those just given. Now, if we take from the Kentucky section this upper sandstone and the beds intervening between it and the Mahoning, we have a general correspondence between the sections in Illinois and Kentucky, perhaps as decided as could be expected to occur in remote portions of the same coal field; the most important difference being in the aggregate thickness of the strata, a variation for which we have already suggested an explanation. Two outcrops of the sandstone, presenting some variation in lithological characters, might easily be mistaken for different beds, and referred to distinct horizons in the construction of a general section, especially where such section was made by a compilation of local sections, predicated upon what appeared to be the general dip and trend of the strata, and any one familiar with the frequent oscillations that occur in the dip of the beds in our western coal fields, will readily perceive how such an error might result from this cause.

But it may be said in objection to these views, that inasmuch as we have only about 500 feet of measures above the conglomerate in the Illinois section, they may represent only the lower part of the Kentucky section, and that we have in Illinois no representation of the strata equivalent to their upper beds. But in answer to this it is only necessary to say that the limestones which occur in the upper 200 feet of the Illinois section contain well marked upper Coal Measure fossils, which agree specifically with many of those occurring in Kansas in beds which have been called *Permo-carboniferous* by Messrs. MEEK and HAYDEN, as indicative of their position at the very top of the Coal Measures, and in 1858 Dr. NORWOOD announced the discovery of *Permian* strata in Illinois, from the striking similarity of the group of fossils occurring in the limestone at LaSalle, to those which characterized Prof. SWALLOW'S so-called

*Lower Permian* beds of Kansas. Furthermore, the lithological characters of the strata composing the upper two hundred feet of the Illinois section, from the amount of calcareous material they afford, resulting in the formation of numerous bands of limestone, would naturally lead to the same conclusion, and we can scarcely doubt that these calcareous beds are at least in part the stratigraphical equivalent of the heavy limestones, shales, clays, etc., of Kansas, forming Prof. Swallow's Lower Permian, more appropriately called *Permo-carboniferous* by Messrs. Meek and Hayden, and which, thickening rapidly to the westward, culminate in thick beds of limestone, altogether, several hundred feet in thickness. Again, our coal No. 5, which is the highest workable bed but one in the series, so far as we know at the present time, is characterized by the same fossil shell, (*Aviculo-pecten rectilateraria*, Cox's sp.), which is relied on in Kentucky as characteristic of their coal No. 9, the highest but one workable bed in that State; and there can be no reasonable doubt but these coals are equivalent strata, holding the same relative position both in Illinois and Kentucky. These views are sustained both by the stratigraphical and palæontological evidence, and although the aggregate thickness of our Coal Measures may be considerably less than they are in Kentucky, nevertheless we have a considerable development of the upper measures, even as far north as LaSalle, and the numerous thin bands of limestone alternating with thin beds of coal, indicate the close relation of the upper portion of the Illinois section with similar beds in Kansas and western Missouri, that have always been referred to the upper Coal Measures.*

Although all the coal seams represented in the Illinois section occur in the strata above the Conglomerate or Millstone grit, nevertheless there are some local developments of coal in the sandstone, where it is fully developed in the southern portion of the State. The conglomerate coals are usually not more than two or three feet in thickness and the extent of their development and their peculiar characteristics will be given more in detail in the reports on the counties where they occur. In the valley of the Illinois, where the principal examinations were made for the construction of the section now under consideration, the conglomerate seldom exceeds 25 feet in thickness and is frequently wanting altogether, so that the fire clay of the coal No. 1 often rests on the Lower Carboniferous limestone. A single development only of conglomerate coal was met with in our examinations in the valley of the Illinois, and this was found in Scott county, and was too thin to be of any practical value. In the southern part of the State where this sandstone attains a thickness of two or three hundred feet, the coal producing conditions appear to have been more favorable, and although the seams occurring in this horizon are generally thin and local in their development, yet they are sometimes found valuable in regions where the higher coals are not accessible.

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*By the terms Upper and Lower Coal Measures, as here used, the upper and lower parts of the true Coal Measures are meant, and these divisions are merely used for convenience, and not as referring to any natural physical break in the series. We have no Lower Coal Measures here, equivalent to what is so termed by British Geologists, below the horizon of the Mountain Limestone.

We will now describe briefly the coals in the foregoing section, with the principal points where they have been identified in the region already examined, noticing such facts as may be of value to the practical miner and those directly interested in coal mining.

The lower, or No. 1 coal of the Illinois section, is the Exeter coal of Scott county, which has been opened at many points in that and the adjoining counties on both sides of the Illinois river. It was originally worked in Scott county, near Winchester, and at FROST'S coal banks, (now MOORE'S), eight miles from Winchester, on the Little Sandy, by stripping off the thin beds of superficial material that covered the coal in the valleys of the streams. It is now worked at the last named locality and in the vicinity of Exeter by drifting into the hill sides along the line of outcrop, and near Winchester by a shaft carried down through the drift and shale to the coal. At Neeleyville, in Morgan county, this seam was opened by a shaft, and was found about 35 feet below the Neeleyville coal. In Schuyler county it is found at the base of the bluff one mile above Frederick, and has been opened by drifting on Mr. SPILLER'S place. It is usually overlaid by a hard bituminous slate, which forms an excellent roof. In Scott and the adjoining counties this coal is usually underlaid, first by two or three feet of impure fire clay, next by a very hard nodular steel gray limestone, which is succeeded by ten to twelve feet of light gray potter's clay. At some points, however, the limestone and potter's clay are wanting, and the fire clay rests directly on the limestone of the St. Louis group. The coal usually ranges from two to three feet in thickness and is of fair quality. The black slate of the roof contains a few fossil shells, among which the *Discina nitida*, *Productus longispinus* and *Lingula umbonata* are the most common. In the extreme northern portion of the State this seam has not yet been positively identified, and it appears to be more uncertain in its northern development than some of the higher seams.

Coal No. 2 is the lower seam at Murphysboro, the Colchester coal in McDonough county, the Morris coal of Grundy county, the lowest seam at LaSalle, the Braceville coal, the lowest coal in the Pontiac shaft? the Neelyville coal and the lower seam near Carbondale. At Murphysboro it is divided by a clay parting a few inches thick, and in Schuyler county, between Pleasant View and the river bluffs, we find two seams of coal separated by two or three feet of shale, which may probably be referred to this coal. It varies in thickness from two to five feet, and affords a coal of excellent quality. At Murphysboro that portion of the coal below the clay parting appears to be sufficiently pure and free from pyrites to be used in its raw state for smelting iron. This coal usually has a roof of clay shale, and at some localities, as at Neelyville, a few inches of coal has to be left to strengthen the roof. The roof shales of this coal contain a great variety of fossil ferns in a very fine state of preservation, and at several localities, especially in Grundy county, the shale contains many nodules of impure iron ore, inclosing ferns, crustacea, insects, and a few fishes in a remarkably fine state of preservation. Although these iron nodules are quite rare at some localities where this coal is exposed, and might be overlooked by the careless observer, we have found them both at Colchester and Murphysboro, and have no doubt that they will be found very generally associated with this coal wherever the overlying shales are well exposed.

Coal No. 3 is somewhat local in its development, but has been identified at two or three localities. It outcrops on Coal creek, in Schuyler county, about a mile and a half southwest of Frederick. This coal is here from three to four feet thick and is overlaid by a dark shelly limestone, sometimes concretionary in its structure and full of fossils, among which are *Cardiomorpha Missouriensis* associated with some small chambered shells belonging to the genera *Nautilus* and *Goniatites.* Near Colchester this limestone is found about thirty-five or forty feet above coal No. 2, but there is only a streak of coal associated with it. In the vicinity of Pleasant View, and about a mile northeast of FARWELL'S coal shaft, this limestone is found in descending the small branch on the north side of the plank road, but the coal is here replaced by bituminous shale. This is probably the equivalent of the upper seam at Murphysboro, or at any rate holds about the same stratigraphical position, but it does not appear to be represented at all in the shaft at LaSalle.

No. 4 is a local coal, which has only been identified at a single locality. It was found near Cuba, in Fulton county, at Mr. EFFNOUR'S place, and outcrops about twenty feet below No. 5, or the main coal, at that point. It is about four and a half feet thick, and is overlaid by bituminous shale and sandstone. No fossils were seen in connection with it.

No. 5 is one of the most reliable coals in the series, and is found almost universally developed wherever the proper horizon has been examined. It is the Howlett coal, found in the shaft near Springfield, at a depth of 230 to 250 feet below the surface, the Pleasant Plains coal, the Rushville and Pleasant

View coal, in Schuyler county, the lower coal in the shaft at Petersburg, in Menard county, the lower coal at the old Pittsburg mines, in St. Clair county, the lower coal at Kingston and on the Kickapoo, in Peoria county, the middle coal in the LaSalle shaft, the lower coal one mile west of Brighton, in Jersey county, and probably the DuQuoin coal, in Perry county. I am not quite positive as to the identity of this seam with the coal at the last-named locality; but from the best evidence I have been able to obtain, I am inclined to regard the DuQuoin coal as No. 5 of the general section, although this and the succeeding coal No. 6 are so near together, and are associated with beds so similar in their lithological characters, that it is often difficult to determine to which seam an outcrop belongs, where only one is developed. Both seams have usually a limestone roof, and are underlaid by a dark fire clay inclosing limestone pebbles, or passing into a nodular argillaceous limestone, so that unless the characteristic fossils are abundant, it is often difficult to determine whether a coal occurring near this horizon should be referred to one or the other of these seams. No. 5 is, however, usually well characterized by the fossil shells that occur abundantly at most localities in the bituminous shales above it. These are *Aviculopecten rectilateraria*, *Discina nitida*, *Lingula umbonata*, *Cardinia? fragilis*, (Cox's sp.,) *Solenomya soleniformis*, (Cox's sp.,) and the variety of *Productus longispinus*, described by Messrs. NORWOOD and PRATTEN under the name of *P. muricatus*. In Kentucky the first-named species is mainly relied on to identify their coal No. 9, which is probably the equivalent of this, and it is found abundantly at LaSalle and in Gallatin county over this coal; but in the central part of the State the *Discina* and *Lingula* are the most common fossils in the bituminous shale above it. In the nodular limestone below this coal, no characteristic fossils have been observed.

The coal from this seam is of excellent quality, and at some localities, as at Howlett, in Sangamon county, the coal is remarkably free from sulphuret of iron, and from experiments recently made, seems to be pure enough to be used in the raw state for smelting iron. It is a harder and heavier coal than that from the seam above it, and appears to be by far the most valuable coal yet discovered in this portion of the state.

Coal No. 6 is the Belleville and Caseyville coals, and the upper seam at the old Pittsburg mines, in St. Clair county, the Hodges' creek coal, in Macoupin county, the upper seam one mile west of Brighton, in Jersey county, the upper coal at Kingston and on the Kickapoo, in Peoria county, the upper seam at Petersburg, and the three feet seam in BEARD and SANDERSON'S shaft, near Springfield, the upper coal at LaSalle, and the Sparta coal, in Randolph county, and most probably the coal reached in the shaft at Carlinville at the depth of 275 feet. In the southern part of the state it is generally from six to seven feet in thickness; in Peoria, Fulton and LaSalle, from four to five feet, while in Sangamon and Menard its thickness varies from a few inches to three feet. The bituminous shale above it is usually quite thin, and is succeeded by limestone and calcareous shales, that locally attain a thickness of fifteen or twenty feet. Fossils are usually abundant where this limestone is well developed, and taken as a group they present a peculiar aspect quite unlike those associated with the lower seams. The outcrop of this seam of coal and its associated limestones in St. Clair county, affords the best possible opportunity to study its characteristic fauna, and the following species are abundant at the Caseyville and Pittsburg mines, viz: *Spirifer cameratus, Productus costatus? P. Prattenanus, P. Wilberanus, Chonetes mesoloba, C. granulifera, Athyris subtilita* and *A. Royissii.* More rarely we find *Productus punctatus, P. longispinus* (var. splendens of NORWOOD and PRATTEN), with spines of *Archæocidaris,* and plates and joints of crinoidea; and near Belleville we find *Petrodus occidentalis.* In the nodular limestone below this coal, *Bellerophon nodocarinatus, Naticopsis* like *N. Altonensis, Spirifer lineatus* and *Chætetes milleporaceus* occur. On Hodge's creek this last-named species is associated with a peculiar group of small univalve shells* that have, as yet, been met with in no other locality.

This is the highest seam in the Illinois section that attains an average thickness of more than two feet in any part of central or northern Illinois hitherto examined. In St. Clair county, at the old Pittsburg mines, this seam is only about sixty feet above the base of the measures, a fact probably due to the irregular distribution of the lower part of the Coal Measures at that locality, and hence it is not surprising that it should have been regarded as one of the lower coals, until explorations had been extended into other portions of the State, where the lower part of the measures attained their normal development. The coal afforded by this seam is generally softer and lighter than that from No. 5, and the seam is more uncertain and irregular in its development, and consequently more expensive to mine from the frequent occurrence of "horse-backs" than No. 5. We have never seen both these coals developed at the same locality to their maximum thickness; but where one attains a thickness of six to seven feet, the other will be quite thin, or, perhaps, entirely wanting. This is the case in St. Clair county where No. 6 is fully developed and No. 5 is too thin to be worked profitably; while in Sangamon and Menard counties the lower seam averages about six feet in thickness, while the upper varies from a few inches to three feet. In Peoria and Fulton counties they both attain a workable thickness, ranging from four to five feet, but do not reach the maximum attained at points farther south.

Above this coal we find a series of sandstones and shales, alternating with thin beds of limestone, with five or more thin seams of coal ranging from a few inches to two feet in thickness.

Coal No. 8 is the small coal outcropping on the breaks of Spring creek, in the vicinity of Springfield, and on the Sangamon, at Howlett, where it averages about two feet in thickness, and affords a coal of fine quality. It can only be worked with profit where its outcrop is in close proximity to a good market, and since the opening of the lower and thicker seam, and consequent reduction in the price of coal, it will have to be abandoned. The seams above this, as well as No. 7, have not yet been found thick enough in Northern Illinois to be of practical value in the production of coal.

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*See Vol. II, pl. 28 and 31, pp. 351 to 360.

The coal mining interests of the State are now undergoing a rapid development, and coal is taking the place of wood on all our principal railroads, and for the production of steam in our mills and manufactories, and also to a great extent for domestic purposes. The product of our coal mines for the past year, (1867), according to the most reliable statistics we have been able to obtain, is fully 1,500,000 tons, notwithstanding the embarrassments some of our principal mining companies have encountered from strikes among the miners, some of which have continued for several months, causing a total suspension of mining operations for the time; and there is no doubt but there will be a constant annual increase in this branch of our mineral productions from this time forward, as new mines are constantly being opened along the principal railroad lines, as fast as the demand for coal justifies the investment of the required capital. There is perhaps no other area of equal extent in the United States, where coal is so easily obtained with a moderate expenditure of capital as in the Illinois Coal Field. This results in part from the undisturbed condition of the strata, and from the position that the principal seams occupy near the middle of the measures, rendering them accessible by shafts almost anywhere in the central portion of the State, at a depth ranging from 200 to 400 feet. The dip of the coal from the western borders of the State to Springfield, is to the eastward about seven feet to the mile. On the eastern borders of the State no detailed examinations have yet been made, but it is not probable that the western dip of the strata will be found to be much greater than that in the opposite direction. Hence the mining engineer will be able to estimate with considerable accuracy at what depth coal may be reached at any point in the centre of the coal field, from a knowledge of the surface level and the general dip of the strata. This will greatly facilitate mining operations by imparting confidence to those having the means to invest in mining enterprises, and enable them to calculate with a degree of certainty as to the amount required to put a coal mine in successful operation at a given point, thus relieving this branch of mining from the risk and uncertainty usually attending similar enterprises for the development of the metalic ores.

*Lead Mines of Hardin County.*—These mines, which are in the St. Louis group of Lower Carboniferous limestones, were first opened in 1842, and were worked for about nine years, when they were abandoned for the want of the necessary capital to prosecute the work successfully. They have been re-opened within the past two years by the "Fair View Lead Mining and Smelting Company," and on a recent visit to the locality, I found them in successful operation. The following statement of their operations since the re-opening of the mines, was kindly furnished by H. M. THOMPSON, Esq., in a letter bearing date December 13, 1867, from which the following extracts, relating especially to their mining operations since the re-opening of the mines, are given:*

"Our operations commenced with the clearing out and opening of what is called the 'Good Hope,' or 'Engine Shaft,' of Mr. BARBOUR, in October, 1865. The following spring we erected an engine and mineral house, blacksmith shop and several cabins upon the property, and placed a large engine and boiler upon the grounds, with pumps, crushers and washers, and separators of mineral, in a permanent manner and on an extensive scale. The engine and pumps are considered of capacity enough to carry the shaft several hundred feet deep.

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*For a detailed report of the Lead Mines of Hardin county, See. Vol. I, Chap. XIII.

This shaft is now 160 feet deep, 6 feet by 8, and excellently cribbed up. Mr. Barbour had sunk this shaft about 115 feet and made drifts as per diagrams in your report.* The present company, which was incorporated in the spring of 1867, under the name of the Fair View Lead Mining and Smelting Company, have confined their work mostly in this shaft to extending the Barbour drifts, and making new ones, and to taking out the fluor-spar and galena thus exposed. They erected a small reverberatory furnace in November, 1866, and up to December 1st, 1867, they had taken out and smelted lead as follows: 2440 pigs of lead, or 176,387 pounds, from 273,040 pounds of ore; nearly all of which came from the Good Hope Shaft, yielding $64\frac{6}{10}$ per cent.

"In September, 1867, the Company commenced clearing out the Whim Shaft, of Barbour, (now called the 'Barlow Shaft'). It is now 80 feet deep and well cribbed, has a good whim, shed and pumps. Excellent mineral filled the lode as they drifted south on the vein, at a depth of 80 feet. No drifts have yet been made north. We have also sunk a shaft (called 'Thompson's Shaft'), near the house, at what was called the 'Anderson Well Lode,' and have it thoroughly cribbed up. It is down 60 feet, and yields much fluor-spar well impregnated with mineral. Our Mining Engineer, Capt. Tippitt, pronounced it a *superior vein*, for the amount of work that had been done on it. This is on the crop vein to the 'Good Hope' lode, and is satisfactory proof of its existence and extent.

"The vein at the 'Good Hope,' 'Barlow' and 'Thompson' lodes is of the same character and width, averaging eight feet, and is nearly perpendicular, and filled with fluor-spar, principally, throughout its whole extent; the mineral being disseminated unevenly through the most of it.

"Assays of the *mineral* give, as a fair average, 85 per cent. of lead to the 100 pounds, and the lead yields 266 grains of gold and 532 grains of silver to the 100 pounds, as per Dr.

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*See Vol. I, Pl. 1 *a*, facing page 367.

THEODORE WEISS' assay certificate. As yet, the Company have not attempted the separation of the silver in a large way, but contemplate doing so.

"We commenced with about six miners and laborers in October, 1865, and have gradually increased their numbers up to the present time, making them now, all told, about sixty. We find a fair market for our fluor-spar, and have recently contracted with responsible parties for the sale of all the mines will yield. These mines are excellently located on the Ohio river, with a steamboat landing on the property, and I may say that we consider them as well fitted up with machinery as any mine in the United States, and have no doubt of their value or productiveness for the future."

Fluor-spar veins similar to those above described, are found in other portions of this, as well as the adjoining county of Pope, the exact localities of which will be found stated in the reports on these counties in Volume I. At "Lead Hill," in Hardin county, considerable galena has been obtained from a shallow opening on the vein, and the prospect for the development of a productive mine at that locality is very good, although it is considerably farther from the Ohio river than the mines at Rose Clare, and the product would have to be transported a distance of three or four miles to the nearest shipping point on the river.

The operations at the Iron Furnaces, in this county, are still suspended, awaiting a sufficient investment of capital and skill to render the enterprise successful.

# CHAPTER II.

## ALEXANDER COUNTY.*

This county forms the southern extremity of the State, and is bounded by the Mississippi on the west and south, by the Ohio and Cache rivers on the east, and by Union county on the north. It includes an area of about 220 square miles, more than one-half of which is alluvial bottom land, occupying the borders of the streams above named, and in the southern portion of the county these bottoms extend entirely across it, from the Cache river to the Mississippi. The bottom lands are generally flat, and are interspersed with Cypress ponds and marshes, and a portion of them are too wet for cultivation without a thorough system of drainage, and are subject to annual inundations from the floods of the adjacent rivers. The most elevated portion of these lands, however, has a light, rich, sandy soil, and is susceptible of a high state of cultivation. They are heavily timbered with white oak, swamp white oak, bur oak, Spanish oak, yellow poplar, (tulip tree), shell-bark and pig-nut hickory, ash, beech, and white and sugar maple, all of which are found on the highest bottoms, and indicate a soil sufficiently dry for cultivation. The swampy lands are characterized by the growth of the cypress, sweet gum, pecan, tupelo gum, cottonwood, willow, etc.

In the northern portion of the county the Silurian and Devonian formations predominate, and the surface is roughly broken, and the arable lands are mostly confined to the creek bottoms and the more gentle slopes adjacent to the streams. The river bluffs above Santa Fe are generally steep and rocky, often presenting towering cliffs, or rugged chert hills, entirely destitute of timber, or but partially covered with scrubby trees and shrubs that find a scanty foothold in the rocky surface. The southern boundary of these older formations is also defined by a line of bluffs, similar in their appearance to those on the Mississippi. These extend about half way across the county, in the lower part of township 15 S., and then trend off northeastwardly, leaving a bottom from three to five miles in width between them and the Cache river.

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*This and the three following counties are reported in part from the observations of Mr. HENRY ENGELMANN. A. H. W.

These bluffs appear to have been washed by a powerful stream at some former period, and no doubt owe their origin to the same cause that excavated the valley of the Ohio.

The following section illustrates the relative position and thickness of the formations in Alexander county:

| | | |
|---|---|---|
| | 20 to 30 feet. | Alluvium. |
| | 50 to 60 feet. | Tertiary. |
| Lower Carboniferous. | ? | Lower Carboniferous limestone ? and Silicious shales. |
| Devonian. | 40 to 50 feet. | Black slate, passing into Silicious shales and flint rock. |
| | ? | Hamilton, Corniferous and Onondaga groups. |
| | 250 to 300 feet. | Oriskany group, Clear creek Limestones. |
| Upper Silurian. | | Band of brown Silicious shales. |
| | 250 feet. | Lower Helderberg Limestone. |
| Lower Silurian. | 150 feet. | Cincinnati group, limestone, shale and sandstone. |
| | 75 feet. | Trenton Limestone. |

The alluvial deposits of this county, as we have already remarked, cover the lower portion of the county, from the south line of township 15 south, to the Ohio river; they also skirt the western bank of the Cache river, nearly to the north line of the county, and occupy a large portion of township 14 east, range 3 west, in the northwest corner of the county, forming a wide bottom between the limestone bluffs and the Mississippi. They consist of irregularly stratified beds of sand and loamy clay, alternating with vegetable humus, similar to those seen almost anywhere along the banks of our large rivers. Their greatest thickness above the low water level of the river, probably does not exceed thirty feet.

*Tertiary.*—The outcrop of this formation, as we have elsewhere remarked, is restricted to a few of the most southern counties in the State, and although we have obtained fossils of this age from localities much further north, we have been unable to identify the strata from which they came. The Tertiary group forms a narrow belt across the southern portion of the State, overlying unconformably the most southern outcrops of the palæozoic rocks. Beginning on the Mississippi, just above Santa Fe, in this county, it forms a narrow belt extending south to the alluvial bottoms, and very probably underlying these, it extends eastward through the southern extremity of Pulaski, Massac and Pope counties, terminating on the Ohio river, along the lower course of which, it forms numerous outcrops. The best exposure of beds belonging to this group, in this county, we found near Santa Fe, on a small creek, which empties into the Mississippi just above the village. They consist of a series of sandstones and shales, with variegated clays, which were overlaid by a bed of ferruginous conglomerate precisely like that on the Ohio river, in Massac county. These beds form the following section here:

| | |
|---|---|
| Ferruginous conglomerate | 4 feet. |
| Yellowish sand and sandy shale | 15 to 20 " |
| Variegated clays | 6 " |
| Sandstone and shale | 25 to 30 " |

These beds dip strongly to the southward, and probably plunge beneath the Alluvium of the Mississippi bottoms. Specimens of silicious wood are common in this vicinity, and may be picked up in the ravines intersecting these beds, but no other fossils were obtained from the group in this county.

The variegated clays are vermilion colored, purple and yellowish, though sometimes nearly white. There are some spots of vermilion in the sandstone and shale, though the prevailing color is an ashen gray. These beds form the bluffs of the river for about a mile above Santa Fe, when the shales of the Cincinnati group come in, and a short distance back from the river they are overlaid by the succeeding limestone. Mr. Engelmann mentions the occurrence of a thin seam of lignite close to Santa Fe, but does not give its thickness or its relative position in the group, but we did not meet with it in our examinations in this vicinity.

*Lower Carboniferous Limestone and Silicious Shales.*—No outcrop of limestone, that could be properly referred to the Carboniferous period, was seen in this county; but Mr. Engelmann describes outcrops of this limestone on the east side of Mill creek, in Pulaski county, and suggests that it may possibly extend further west into the northeast corner of Alexander. Silicious shales, probably of the age of the Kinderhook group, occur in township 14, range 1, on Grime's creek, and outcrops are noticed by Mr. Engelmann on sections 6 and 7. These Silicious shales are associated with a loose chert, that has probably been derived from an overlying limestone, the calcareous portions of which have entirely disappeared by decomposition, under the influence of atmospheric agencies. The exposure of these shales did not admit of an accurate measurement at any of the outcrops that were seen.

## DEVONIAN.

### BLACK SLATE, HAMILTON AND CORNIFEROUS BEDS.

The black slate is reported by Mr. Engelmann as outcropping on a branch of Caney creek, in the eastern part of section 17, township 14, range 1 west, the slope above being covered with silicious shale and chert of the Lower Carboniferous series. This formation is associated, in this county, with some cherty, silicious limestones, which pass into a compact, brittle flint-rock, that probably represents the Hamilton and Corniferous beds, if they are represented at all in this county. These last named beds are quite silicious and cherty in Union county, and probably thin out and disappear to the southward, becoming more and more silicious and cherty in that direction; for, in Tennessee, north of Nashville, where we have had an opportunity of examining the beds at this horizon, the black slate is found immediately overlying the Upper Silurian limestone, with no indications of the presence of the intervening limestones of Devonian age, which we find in Illinois, and which are here more than 300 feet in thickness.

## ONONDAGA GROUP.

Underlying the silicious rocks above described, we find in this county some striped silicious shales, which, in this region, are known under the local name of "Calico rock," and these pass downward into a white, quartzose, massive sandstone, sometimes so soft and incoherent in its structure that it readily crumbles to sand under a blow of the hammer, while at other points it becomes exceedingly hard, and partakes of the characters of a true quartzite. The entire thickness of this sandstone, with the striped shales above it, probably will not exceed an average of fifty feet. The sandstone is locally fossiliferous, and its characteristic species in Union county, where it has been more thoroughly examined, will be given in the report on that county. Mr. ENGELMANN estimates the thickness of the sandstone at not more than thirty feet, and it is seldom that a thickness of more than fifteen or twenty feet can be seen at a single outcrop. The principal exposures of this sandstone are the following: On the head-waters of South Ripple creek, near the north line of section 8, township 14, range 2, and continuing thence southward to the hills on the upper course of Sexton creek, on the southwest quarter of section 21, and the northwest of section 20. Its outcrop also continues round the head of Sandy, and forms a part of the high ridge east of that creek, and with a northeastward dip, it descends to the edge of the flats on the southwest quarter of section 19, township 14, range 1 west, and then disappears below the water level. Its most easterly outcrops are the one last mentioned, and one on the northeast quarter of the same section, on the Jonesboro road, between Jackson and Caney creeks, on section 24, and the southeast corner of section 23, township 14, range 2, and also on James creek, not far from the Union county line, on section 2 of same township, to the east of which this sandstone disappears below the creek level.

The overlying silicious shales are also but seldom well exposed, but were seen at the edge of the flats west of Caney creek, on the northwest quarter of section 20, township 14, range 1 west, in the lower part of the steep hills on the east side of the Jonesboro road, near Caney creek, on the southwest quarter of section 18, also on the northwest quarter of the same section, also on the southeast quarter of section 12, in township 14, range 2 west, and on the hills north of Grimes creek, near the Union county line, on the northeast quarter of section 2, in the same township, and thence descending eastward along the creek to the east line of section 2, and perhaps even to section 6 of the adjoining township 14, range 1 west. From thence it extends westward, probably nearly as far as the sandstone, but the outcrops were generally hidden in the slopes of the hills. These silicious shales have afforded no fossils, as yet, to enable us to determine precisely to what part of the Devonian age they most properly belong, but their immediate connection with the sandstone, which, from its fossils, appears to represent the Onondaga limestone, has induced us to include the shales also in the same group. The out-crop of this sandstone, and the silicious shales associated with it, cause a decided change in the topographical features of the country, wherever they apppear; the high precipitous hills, formed by the cherty limestones below, disappear, and the country becomes comparatively level, and better adapted to agricultural purposes.

## ORISKANY GROUP.

*Clear Creek Limestone.*—In the first Volume of the Report on the Geological Survey of Illinois, we included, under this name, the great mass of cherty and silico-magnesian limestones, which were found in the southern portion of the State, immediately above, and resting upon strata of Lower Silurian age, that were referred without hesitation to the Cincinnati group of our general section, because we were unable to discover any decided change in the lithological characters of the rock, that would enable us to fix with certainty a line of division between what were evidently beds of distinct geological age. Subsequent investigations, and a more complete collection of the fossils which belonged to the upper and lower divisions of the mass, led to the conclusion that the upper division represented, at least in part, the Oriskany period, and the lower, the Delthyris shale beds of the Lower Helderberg series of the New York Geologists. Hence, in the Second Volume of the Illinois Report (see Introduction, p. viii.), we separated the beds in accordance with the palæontological evidence, although still unable to find any well marked line of separation on lithological grounds. More recently we have again visited Perry county, in Missouri, where this group is well exposed, and in the hills to the southwest of Wittemberg, we found a bed of calcareous shale, only a few feet, apparently, in thickness, and occupying a stratigraphical position about midway in this group of cherty limestones. At the lowar terminus of the exposure of these rocks, below Bailey's landing, where they consist only of the lower division of the series, we also observed that the limestones were succeeded apparently by a similar shale, in loose masses, strewn along the shore of the river, immediately below the point where the fossiliferous beds of limestone dipped below the river level. This bed of shale did not appear to attain a thickness of more than ten or fifteen feet, and, I have no doubt, forms the line of demarcation between the Upper Silurian and Devonian strata.

In the section of the rocks of Alexander county, given on a preceding page, we have included the cherty limestones above this brown shale in the Devonian series under the name of Clear creek limestone. At some localities it is quite calcareous, and consists of alternations of thin bands of silicious limestone and chert, passing locally into heavy beds of chert. In this county limestones are less abundant in this group than in the counties north of this, and it is here almost entirely made up of chert-rock, and cherty silicious shales, which form, by decomposition, a white plastic clay, locally known as "Chalk Banks." Its maximum thickness in this portion of the State may be estimated at about two hundred and fifty feet, but no locality was seen in this county where it could be accurately measured. It caps the river bluffs in the northwest part of the county, and outcrops over the northwestern part of township 15 south, range 2 west, the eastern part of sections 1, 12 and 13, in range 3 west, the southwestern part of township 14 south, range 2 west, and some of the adjoining portion of range 3 west. The region underlaid by this formation is usually very broken and hilly, and the arable land is restricted mainly to the valleys of the streams. Its outcrop forms steep hills, the slopes of which are covered with loose masses of flint, without timber, except upon the summits, and even these are but scantily covered with a scrubby growth. Very few fossils were obtained from this group in this county, and a list of its most characteristic species will be given in the report on Union county, from which most of the species have been obtained.

*Lower Helderberg Limestone.*—This is the next group in the descending series, and commences, as already observed, with a few feet of brown shale, succeeded by thin beds of silicious limestone, alternating with layers of chert. The chert also ramifies through the limestone strata in bands and nodules. Towards the base, the calcareous matter predominates, and we find some heavy beds of mottled limestone, the predominating colors being brownish red, gray, and buff. At the base of the upper Silurian formation in this county, we find at one locality, about two miles above Thebes, a coarse grained steel-gray limestone, from three to four feet in thickness, containing the peculiar group of fossils figured on plate 6, of this volume, the most remarkable of which is the fine Trilobite, the *Dalmanites Danæ*, which has not yet been identified at any other locality in the state. The species figured on this plate are associated in this bed with a globular coral, like Heliolites, a Zaphrentis, and some other undetermined forms.

These Upper Silurian limestones, attain a thickness of about 250 feet in this county, and the region over which their outcrop extends, differs but little in its topographical features from that of the cherty limestones of Devonian age already described. Indeed, the upper portion of the group now under consideration, can scarcely be distinguished by its lithological characters from the cherty beds that overlie it, and it was entirely on palæontological evidence that we were able to decide that the one was Upper Silurian and the other Devonian. Very few fossils have been obtained from the limestones in this county except from the bed of dark gray limestone at the base. At Mr. W. H. Sanders' place, about five miles north-northeast from Thebes, the reddish brown limestones at the base of the series contained Orthoceratites in abundance, but owing to the hardness and massive structure of the rock, good specimens could not be readily obtained.

Most of the fossils characteristic of the silicious limestones of this series have been obtained from the exposures on the west side of the river, below Bailey's landing, where the whole series of strata pitches below the water level in a distance of about a quarter of a mile, affording such an opportunity of examining the different layers as we have found nowhere else. The species obtained from this locality are the following, that appear to be identical with, or closely allied to, species that are considered characteristic of the Lower Helderberg limestones of the New York series: *Orthis subcarinata*, *Cyrtina Dalmani*, *Trematospira imbricata*, *Spirifer perlamellosus*, *Acidaspis hamata*, *Platyceras spirale*, *P. pyramidatum*, etc.

The general outcrop of these Upper Silurian rocks is along the Mississippi bluffs, and forms a narrow belt, extending eastward from the bluffs, to the distance of from one to three miles. They also outcrop along the range of inland bluffs, running northeasterly from Santa Fe, and extend nearly to the point where they bend abruptly to the northward, on section 28, township 15 south, range 2 west. The cherty portion of this limestone forms, by its decomposition, a white chalky clay that can scarcely be distinguished from that of the Devonian cherts, one of which was seen, according to Mr. ENGELMANN, on the southwest quarter of section 3, township 16 south, range 3 west. Taken as a whole, the conditions under which these Upper Silurian and Lower Devonian strata were deposited, appear to have been remarkably uniform. Scarcely any changes can be detected in the lithological characters of the strata, and yet we find as decided changes in the specific characters of the fauna which characterize the upper and lower divisions, as we usually find in passing from one geological system to another. I know of no similar example in the palæozoic rocks of the west, where so complete a change has taken place in the organic life which characterizes the different geological periods, without a corresponding change in the physical conditions under which the enclosing sediments were accumulated.

*Cincinnati Group.*—This group is represented in this county by two divisions, the upper one a dark blue compact limestone, and the lower a chocolate colored sandy shale, passing downward into a brown sandstone. The limestone attains a thickness of about forty feet, and has a partly concretionary structure, which gives an uneven surface to the strata. It is a very fine grained compact rock, breaking with a conchoidal fracture, and resembles very closely the "*Glass Rock*" of the lower Trenton beds near Galena. The layers of limestone are separated by thin partings of brown shale, in which the crinoidea, crustacea, and other fossils of this group, are found preserved in a very perfect condition. The most common fossils it affords are the following: *Glyptocri-*

*nus fimbriatus*, *G. decadactylus*, *Tentaculites incurvus*, *T. tenuistriata*, *Asaphus canalis*, *Cyphaspis Girardeauensis*, *Orthis Missouriensis*, with some undetermined species of *Conularia*, *Cyrtolites imbricatus*, *etc.* This limestone outcrops on a branch of Mill creek, about three miles southeast of Thebes, on the Unity road, where it overlies the chocolate colored shale, and only the lower beds of the limestone are seen. On Orchard creek, about two miles below Thebes, this rock is well exposed, directly on the road from Thebes to Santa Fe. The creek falls twenty-five feet over this limestone at this point, affording a good exposure of the strata. It is quite thin bedded, the layers varying from one to six inches in thickness, and are somewhat flinty. At this point the shale below the limestone is not exposed, but on another branch, half a mile below, there is an exposure of forty feet of the shale overlaid by the limestone. One mile and a half above Thebes, on the river bank, the shale is seen overlaid by the limestone, and dipping to the northward. The upper layers here present a finely brecciated structure, and are overlaid by a coarse grained, steel-gray limestone of the Upper Silurian series. Below Thebes no trace of this bed was seen, and the blue limestone was succeeded by heavy beds of mottled red and gray limestone, that usually form the base of the Upper Silurian system in this portion of the State. The blue limestone outcrops also on Sexton's creek, and an exposure of it was met with on the road from Thebes to Jonesboro, on the waters of Miller's creek. All the outcrops of this rock met with in this county are in the vicinity of the river bluffs.

*Thebes Sandstone and Shale.*—This formation, which underlies the limestone above described, is well exposed in the vicinity of Thebes, and the lower portion of it forms the sandstone bluff on which the old court house was built. The lower portion of it only is a true sandstone, and is about thirty feet in thickness, and passes upward into a sandy shale of a dark brown or chocolate color, which we found exposed two and a half miles below Thebes, forty feet in thickness. A half mile below Thebes we found a yellowish brown shale, apparently not above five or six feet in thickness, that evidently formed the base of this group. It was filled with fragments of *Trilobites*, apparently belonging to the *Asaphus canalis*, which, with a *Lingula* found in the upper shale immediately below the limestone, are the only fossils it has afforded. The thickness of this lower division of the group may be estimated at about seventy-five feet, about twenty-five of which is in sufficiently thick beds to be used for building stone and for flags. Some of the sandstone layers are from two to three feet in thickness, and are well adapted for foundation walls, culverts, etc., and it has been extensively quarried at this point and transported to Cairo for building purposes. The only outcrop seen of the beds that are adapted to building purposes, is in the immediate vicinity of the town of Thebes, and as they dip in opposite directions over the underlying Trenton limestone, which forms the center of an anticlinical axis just below Thebes, they soon pass below the water level in each direction. The shaly upper portion, however, outcrops for a distance of about six miles from north to south, commencing about one mile above Santa Fe, and extending to section 27, township 14 south, range 3 west, and forms a narrow belt, nowhere exceeding a mile in width.

*Trenton Limestone*,—This is the oldest formation known in southern Illinois, and its only outcrop on the east bank of the Mississippi, in this county, is just below Thebes, where it forms the obstruction to river navigation, known as the "*Grand Chain.*" It projects across the river in a narrow belt, forming the center of an axis which elevates this limestone to the height of about seventy feet above the low water level of the river. The whole thickness of the group is much greater where fully exposed on the Missouri shore, but only the upper part of the mass is elevated above the river level on the eastern bank of the river, and its outcrop scarcely exceeds a half mile in width, by about two miles in length, along the river shore at the lowest stage of water. It is a light gray or bluish-white crystalline limestone, in heavy beds, generally free from silicious matter, cuts readily, and is susceptible of a high polish, and is adapted to general use as a very fine building stone or marble. It has been extensively quarried for many years in the vicinity of Cape Girardeau, in Missouri, and has become favorably known on the lower Mississippi as the "*Cape Girardeau marble.*" It also makes a very fine white lime, and is extensively quarried on the Missouri shore for this purpose. An analysis* of this limestone from Cape Girardeau, by Dr. A. Litton, of St. Louis, gave 99$\frac{57}{100}$ per cent. of carbonate of lime, which is a remarkable degree of purity for an unaltered limestone. The upper portion of the bed, which is the part best exposed in Illinois, is that from which the finest building stone is obtained in Missouri. The center of the axis which has elevated these Lower Silurian strata above the surface in this county, is about a mile below Thebes, and over this nucleus the overlying beds bend in a saddle-shaped form, with a rapid dip in opposite directions. The principal fossils afforded by the Trenton beds in this county, are *Receptaculites Oweni*, *Strophomena alternata*, *Orthis lynx*, *Rhynchonella capax*, *Illenus crassicauda*, *Lichas cucullus*, *Comarocystites Shumardi*, and a large bivalve shell like *Cypricardites*, and fragments of Orthoceratites. The granular character of this rock is not favorable to the preservation of delicate organic forms, and consequently the embedded fossils are not obtained in as good a condition at this locality as they often are where the limestones are more argillaceous, and the strata separated by partings of shaley material. In the bed of the river just below the town of Thebes, there are some beds exposed which appear to contain considerable silicious matter in the form of chert, and also nodules of a black bituminous substance, which ignites when heated, and burns to ashes. As this is the most southerly point on the Mississippi where good building stone, or limestone suitable for lime, can be obtained, these outcrops must eventually become valuable as a source of supply to the country bordering the Mississippi below Cairo, as well as for the building up of that city.

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*See Dr. Shumard's Report on the Mississippi river section in the Missouri Report, page 155.

Before closing our descriptions of the rocks of this county, we will mention a bed of very hard quartzite, that we found in the hills some two miles back of Santa Fe. Only a single exposure of the rock was seen, not above ten feet in thickness, and having apparently a gentle dip to the northward. No other beds were seen in connection with it that would give any clue to its probable age, but from its color, texture and general appearance, I am inclined to believe that it is a portion of the Thebes sandstone which has undergone metamorphism at this locality, though it presents no signs of metamorphic action any where else that we have seen it exposed. In the hill sides above this outcrop, we found an exposure of a few feet of soft quartzose sandstone belonging to the Tertiary beds of this region, but this did not appear to correspond exactly in dip or lithological appearance with the quartzites below. This outcrop of quartzite appeared to be exactly on the trend of the axis by which the Lower Silurian beds are elevated above the surface in this county. One of the specimens of quartzite obtained here contains some small pebbles of quartz, and as none were seen in the Thebes sandstone, while they were observed in the Tertiary sandstone of this vicinity, it may be that these altered strata belong to the newer, rather than the older sandstones, and if so, we have the curious anomaly of metamorphic strata of Tertiary age overlying beds of Silurian limestone that are unaltered at their nearest outcrop.

## *Economical Geology.*

*Metallic Ores.*—No considerable quantity of metallic ores have been found in this county, or any indications seen that would lead to the conclusion that such deposits will be discovered hereafter. A small amount of galena has been found in the cherty limestones of the Oriskany group, but in too small quantities to be of any economical importance. Brown hematites, or the hydrous oxide of iron, also occurs in small quantities, especially in the ferruginous conglomerate of the Tertiary, but the silicious pebbles which constitute the greatest portion of the mass, renders it worthless as an iron ore. The seams of smut and lignite in the Tertiary also excite expectations of finding valuable deposits of coal, but no such deposits exist in the county, and time and money spent in search of coal in this region will be spent in vain.

*Building Stone and Marble.*—Alexander county has an abundant supply of superior building stone, and when the quarries are properly opened, and the amount and quality of the material they will afford is better known, this will prove a very important branch of industry to the county. First in importance, perhaps, not only from the thickness of the formation, and consequently the large amount of material it will afford, is the Trenton limestone, the principal outcrop of which is in the river bluff just below Thebes. This formation is about seventy feet in thickness above the low water level of the river, and consists of white and bluish-gray limestones, partly in heavy beds of from two to three feet in thickness. It is generally free from silicious or ferruginous matter, can be easily cut into any desired form, and is susceptible of a high polish, and is adapted to various uses as a marble. It has been extensively quarried at Cape Girardeau since the earliest settlement of the country, both for lime and for the various purposes for which a fine building stone was required, and it is already well known and highly appreciated as the "Cape Girardeau marble" along the whole course of the lower Mississippi. For the construction of fine buildings, and the display of elaborate architectural designs, this rock has no superior in this portion of the State.

The mottled beds of the Upper Silurian series consist of hard compact limestone, and are susceptible of a very fine polish, and make a very beautiful marble. The prevailing colors are red, buff, and gray, varying somewhat at different localities. The rock is somewhat silicious, and consequently harder to work than the white limestone of the Trenton group, but it will no doubt retain a fine polish much longer than a softer material, and the variety of colors which it affords, renders it well adapted to many uses as an ornamental stone, for which the other would not be required. These mottled layers vary from ten to twenty feet in thickness, and can be most economically quarried where the overlying strata have been removed by erosion. For table tops, mantles, etc., this is one of the handsomest rocks at present known in the State.

The *Thebes Sandstone* affords an excellent dimension stone, and material adapted to the construction of foundation walls, culverts, etc. It dresses well and is durable, but it would hardly be selected by the architect when in competition with the more beautiful material from the Trenton group. Some of the beds are of suitable thickness, and make good flagstones. All these beds outcrop in the vicinity of the uninterrupted navigation of the Mississippi, and consequently can be made available at a moderate cost to all the lower country bordering on the river, that is destitute of such material, which is the case with the whole region from Cairo to New Orleans. This consideration alone adds much to the value of these southern outcrops of building stone, and will surely lead, ere long, to their thorough development.

*Clay and Sand.*—These materials are abundant and of varieties suited to the various economical uses to which they are usually applied. The clays of the Tertiary formation are valuable for the manufacture of potter's ware, and one variety has been in use at Santa Fe for some years, and produces a ware of excellent quality. That principally used at Santa Fe, in the manufactory of Mr. CHARLES KOCH, is of a gray color, and is sufficiently mixed with sand to be used without any further addition of that material. Before burning, the ware receives an outside washing of the white clay found near by, to improve its color, and an inside wash of Mississippi river mud, to improve the glazing. The white clays of this vicinity appear to be well adapted to the manufacture of ordinary white ware, but have not been thoroughly tested. The white clays resulting from the decomposition of the silicious beds of the Devonian series, seem also to be suitable for the same purpose. Sand abounds in the Tertiary beds of this region, and also more abundantly in the alluvial beds of the creek and river bottoms. The Devonian Sandstone, common in the northeast part of the county, is often quite pure and free from coloring matter, and is well adapted to the manufacture of glass. Although not in close proximity to the coal beds, yet the facilities afforded by the Illinois Central Railroad would secure the required fuel from DuQuoin or Murphysboro, at a very reasonable cost.

*Road Material.*—An inexhaustible amount of the very best material for the construction of turnpike or common roads, abounds on all the water-courses that intersect the uplands of this county, and is derived from the cherty limestones of the Upper Silurian and Devonian age. It consists of a brown flint or chert, finely broken for use, and occurs abundantly, filling the valleys of the small streams that intersect the limestones above named. This flint has been used at St. Louis for the manufacture of "concrete stone," and has been found fully equal to the best English flint for this purpose. The material with which this experiment was made was obtained in Union county, but it differs in no way from the flint so abundant in this county, and is derived from the same beds.

*Agricultural resources.*—As we have already observed, the uplands of this county are generally broken into steep hills or ridges, and the arable land is mainly confined to the alluvial lands of the rivers and smaller streams. There is, however, a small area in the northeast part of the county that is underlaid by the Devonian sandstone, and the striped shales associated with it, where the surface is not so abruptly broken, and affords some good farming lands. The soil is mostly a yellow clay. The uplands are covered with timber, where the surface is not too rocky, consisting of black and white oak, hickory, beech, yellow poplar, or tulip tree, etc.

On Sexton's creek the bottom is narrow along its upper course, and is heavily timbered with walnut, maple, beech, oak, etc., until it leaves the cherty limestones, and in range 3 the bottoms become wider, averaging perhaps a quarter of a mile in width. On Miller's fork, east of Thebes, the arable land begins at the foot of the breaks on the outcrops of Upper Silurian limestone, but is too narrow for cultivation down to section 14, where it widens for a mile or more, and then becomes low and wet, and so continues to its outlet into the Mississippi. Mill creek bottom, south of the Union county line, averages about a half a mile in width, and has some fine sloping lands on either side, which are heavily timbered. Below the last bluff on the creek, east of Ullin, the bottom is very heavily timbered with swamp white oak and yellow poplar, many of the trees reaching a diameter of from four to six feet. The branches of Caney creek, in the northeast part of the county, where they traverse the outcrops of the Devonian slates, have fine arable bottoms and slopes. On the southeast quarter of section 18, township 14, range 1, the creek bottom is about a quarter of a mile in width, and below this it becomes gradually wider until it joins the flats of Mill creek. From these topograpical features it will be seen that the amount of arable land in this county is limited, and restricted to the higher portions of the river bottoms, and the narrow valleys of the small streams. But wherever these bottom lands are dry enough to admit of cultivation, they are very productive, having a light, warm, sandy soil, that yields large crops of corn, cotton, tobacco, and most other products suited to the climate. Small fruits and peaches will also do well on the dryest bottom lands, and grapes, apples, pears, etc., may be successfully cultivated on such of the highlands as are not too steep for cultivation. The advantages of climate in this extreme southern portion of the State, which enables the fruit-grower to put his fruit in market in advance of that raised in any other section north of the Ohio, will always make this a desirable region for the cultivation of such fruits as are most desirable for the early markets. These rich bottom lands are equally desirable for the market gardener, and Cairo, Chicago and St Louis could be supplied with early vegetables from this portion of the State several weeks earlier than from central Illinois.

# CHAPTER III.

## UNION COUNTY.

Union county is situated immediately north of Alexander, and is bounded on the north by Jackson and Williamson counties, on the east by Johnson county, on the south by Alexander and Pulaski counties, and on the west by the Mississippi river. It embraces the western end of the summit or dividing ridge which crosses southern Illinois from Bald Rock, on the Big Muddy, to the mouth of Saline river, on the Ohio, and contains an area of a little more than eleven townships, or about 400 square miles, of which about one-fifth is bottom and the remainder upland. It is for the most part heavily timbered, except on some of the most rocky hills and ridges. It comprises one of the best timbered districts of the State, and although very broken and hilly along its western borders, presenting a topography quite unlike the central and northern portions of the State, it nevertheless has a large proportion of excellent soil, well adapted to the growth of corn, cotton, tobacco, and all varieties of fruit adapted to the climate.

The surface configuration of the different portions of the county is mainly dependent on the character of the underlying strata, and the amount of disturbance to which the rocks have been subjected. The general trend of the line of uplift in this county is from north-west to south-east, and the dip, with some local variations, is to the north-eastward. Hence the escarpments on the south and west sides of the ridges, are steeper and more rugged than those to the north and east. The river bluffs are high and rocky, and are frequently cut up into rugged declivities and sharp summits, and are formed by the cherty limestones of Upper Silurian and Devonian age, which constitute the more southern extension of the same bluffs into Alexander county. In the north-eastern portion of the county we find the sandstone ridge already alluded to, which forms the water shed between the streams running northward into the Big Muddy, and those running south into the Mississippi and the Ohio. This ridge presents a perpendicular escarpment on its southern face similar to the bluffs of our large rivers, although its course is nearly at right angles to the present water courses. Its summit is formed by the Conglomerate sandstone, and its base by the Lower Carboniferous limestones and sandstones of the

Chester group. South of this chain of bluffs, and extending along the line of the Illinois Central Railroad, from Cobden to the south line of the county, there is a broad belt of country underlaid by the Lower Carboniferous limestones, in which the ridges are less abrupt, and the surface so gently rolling as to be susceptible of the highest cultivation.

The country north of this sandstone ridge is also underlaid by the Conglomerate sandstone, and is generally broken and hilly. The creeks run in narrow gorges, with scarcely any breadth of bottom land, but the ridges, unlike those formed by the cherty limestones, are susceptible of cultivation, and are heavily timbered. These ridges are now regarded as the best fruit lands in the county, and command a higher price than the more gently rolling slopes of the limestone region further south.

The river bluffs in the northwest township in this county are known as the "Pine Hills," and are exceedingly rugged. These bluffs form ridges from four to five hundred feet in hight, and so sharp that on their summits there is scarcely breadth enough for a road, while the slopes are very precipitous, and in places rocky. On the summit there are a few stunted pine trees, growing on cliffs of nearly naked chert rock, but where the soil is better, these ridges sustain a growth of black and white oak, hickory, black gum, yellow poplar, etc. Back of the river bluffs there are a series of similar ridges, covering all the western portion of township 11 south, range 3 west, and the south-western part of township 11, range 2 west. In this portion of the county the ridges are too much broken for cultivation, and the farms are restricted to the creek bottoms and the more gentle slopes of the hill sides.

The soil and timber of the uplands in this county, except in the very broken region above mentioned, present a general uniformity of character. The soil is a light brown clay loam, with a subsoil of similar character, and was originally covered with a magnificent growth of white, red and black oak, pignut, scaly-bark and barren hickory, yellow poplar (tulip tree), black gum, beech, black walnut, sugar maple, etc. The post oak, which is the prevailing timber in some portions of southern Illinois, was seen but rarely here along the north line of the county, and the barren oak was also occasionally met with on the ridges underlaid by the Chester sandstone north of Cypress creek.

The bottom lands of this county comprise a belt of about four miles in width along the eastern bank of the Mississippi, and extending to the river bluffs. These lands, where they are not too wet to admit of cultivation, are exceedingly fertile, and are the best corn lands in the county. The growth of timber on the bottom lands is even heavier than upon the uplands, and comprises several varieties of oak, among which are, blue-bark oak, scarlet oak, bur oak and swamp white oak, that are not met with on the uplands; also, sycamore, horn-beam, elm, cottonwood, bald cypress, tupelo gum, white maple, willow, ash, hackberry, pecan, persimmon, red birch, pawpaw, etc. A good deal of this bottom land is too wet for cultivation, and is covered with water, forming ponds, sloughs, etc.

*Geology.*—The geological structure of this county comprises a wide range of formations, extending from the base of the Upper Silurian to the top of the Conglomerate sandstone of the coal measures, through a vertical range of about 2,000 feet of strata. The following section will serve to illustrate the thickness and relative position of the palæozoic rocks of this county.

*Section of the Rocks in Union County.*

| | | |
|---|---|---|
| Carboniferous. | 200 feet. | Conglomerate Sandstone. Massive quartzose sandstone with silicious pebbles, passing into more finely grained and thin bedded brown sandstones. |
| | 800 feet. | Chester group of the Lower Carboniferous series, consisting of alternations of dark gray argillaceous and ferruginous limestones, alternating with brown sandstones, in regular beds, and argillaceous and sandy shales, the latter inclosing locally a thin seam of coal. The limestones are often bituminous, and emit a fœtid odor when struck with the hammer. |
| | 200 to 250 feet. | St. Louis Group: Compact gray limestones, partly light-colored and oolitic in texture, and sometimes dark blue and cherty. |
| | 80 to 100 feet. | Kinderhook Group: Silicious shales and chert. |
| Devonian. | 40 to 60 feet. | Black Slate, and blue and green Shales. |
| | 100 feet. | Hamilton Group: Dark bluish-gray fœtid limestones and shales. |
| | 20 to 30 feet. | Onandaga limestone: Light gray massive silicious limestone. |
| | 40 to 60 feet. | Quartzose sandstones and striped silicious shales. |
| | 200 to 250 feet. | Clear creek limestones of the Oriskany period, consisting of light gray thin-bedded limestones, alternating with layers of chert, passing locally into an irregularly bedded chert rock. |
| Upper Silurian. | | Band of brown arenaceous shale. |
| | 250 feet. | Lower Helderberg limestones: Arenaceous and magnesian limestones, in thin beds, alternating with chert, and at the base passing into a mottled, silicious limestone in heavier beds. |
| L. Sil. | | Cincinnati Group ? |

[illegible] represented in this section, there are the recent [illegible] form the bottom lands, and the beds of marly clay, [illegible] valleys, which may be referred, most pro[illegible] clays which overlie the older rocks on the [illegible] Quaternary system.

[illegible] Limestone.—This formation is similar in its appearance [illegible] described in the foregoing report on Alex[illegible] described as a thinly bedded, grayish-colored, [illegible] limestone, sometimes argillaceous and shaley, [illegible] difficult to say whether the flint or the limestone [illegible] related to the cherty Devonian lime[illegible] that it is difficult so say, when no fossils [illegible] may belong. This limestone forms the base [illegible] county, except for a short distance, where [illegible] intersects the bluff, four miles west of [illegible] of the strata, the result, probably, of a [illegible] sandstone of the Devonian, extending down to the [illegible] overlaid by the massive beds of Onondaga limestone. For [illegible] and mostly through township 12, the bluffs are [illegible] cherty limestones of the Oriskany group, but in township 11, [illegible] range 2, the base of the bluffs consist of [illegible] limestones and the upper part of the cherty Devonian [illegible] sandstone. Beyond the immediate vicinity [illegible] in this county. Along the bluffs these [illegible] that present a peculiar wall-like appear[illegible] and are seen to the best advan[illegible] projecting ledges that are [illegible] No fossils have been obtained [illegible] opposite side of the river, just [illegible] better exposed, the following [illegible] or *C.* [illegible], a *Calo-* [illegible] *Spirifer perlamel-* [illegible] with forms closely resem[illegible] *Platyceras pyramidatum*, *P. ungui-* [illegible] species common in the [illegible] there can be but little doubt that [illegible] same horizon and are the western [illegible]

[illegible] quarter of section 9, [illegible] we observed a bed of [illegible] thickness was exposed, that [illegible] series in northern Illinois. [illegible] we should not hesitate to place this [illegible] rock in the Lower Silurian series, and to regard it as the equivalent of the compact silicious limestone that forms the upper member of the Cincinnati group, in Alexander county, but as we failed to find any fossils in it that would enable us to decide positively as to its age, it may be possible that it is an intercalated bed of the Upper Silurian series. However, we place it at the bottom of the section, with a query, until further examinations can be made. I find no mention of this outcrop in Mr. **Engelmann's** notes, or any intimations that a similar rock was met with in the Upper Silurian limestones of this county.

From Wolf lake to the north line of the county the Upper Silurian limestones form the entire bluff, often reaching a hight of 200 feet or more, in smooth, vertical faces or turreted walls. Fine springs of beautifully limpid water issue from the base of these bluffs at numerous points. Near the head of Wolf lake, and not far from the northwest corner of section 22, township 11, range 3 west, is one of the highest points in this part of the county; the lower limestone reaches an elevation of 200 feet above the Mississippi bottoms, and is capped by 100 feet of the rough chert rock of the Oriskany group, which stand out in bold relief, with a strong easterly dip. These bluffs continue southward, along the eastern borders of Wolf lake, to the northwest quarter of section 3, township 12, range 3, where, in consequence of the easterly trend of the bluffs, or perhaps a break in the strata, these limestones disappear, and the bluffs are formed by the Devonian beds. Following down the river bluffs a distance of about eight miles by the section lines, this limestone again appears, near the north line of section 9, township 13, range 2, and from this point they continue to form the main portion of the bluffs to the Alexander county line.

*Clear Creek Limestone.*—This cherty limestone, or chert formation, as it might very properly be called, occupies the upper portion of the river bluffs in township 13 south, range 2 west, and township 11 south, range 3 west, where the Upper Silurian limestones form the lower part, and in township 12 south, range 2 and 3 west, where these Silurian rocks are below the surface, the bluffs are composed mainly of this cherty rock and the overlying Devonian beds. This formation forms an irregular belt of outcrop along the line of river bluffs, ranging from two to six miles in width. This belt is narrowest in the southern portion of the county, becomes gradually wider in township 12, range 2 west, and attains its maximum width in the south part of township 11, range 2 and 3 west, and from this point gradually becomes narrower to the north line of the county. Its greatest development is on the upper course of Clear creek, and on Higgin's creek, in the northern portion of the county. It also outcrops on all the forks of Caney creek, in the central part of township 12 south, range 2 west, and south of this its outcrop is restricted to a narrow belt along the river bluffs.

Although generally cherty, it presents considerable variety in its lithological characters. Portions of the mass appear as a porous or compact chert, sometimes massive, and again quite evenly stratified, and these cherty beds pass into silicio-magnesian limestones of compact texture, and these, again, into chalky, white limestones, filled with nodules and concretionary masses of compact flint. Some of these changes are probably due to atmospheric or aqueous agencies, by which the calcareous matter has been dissolved and removed; or else the silica has replaced the limestone by a slow chemical action, analagous to that by which, in certain strata, the calcareous shells of Mollusks are changed into silicious fossils. On sections 12, 13 and 14, in township 11, range 2 west, Mr. ENGELMANN notices the occurrence of massive limestones, that assume the appearance of a white marble. On the northeast quarter of section 12, he describes the rock as a delicate, grayish colored and white limestone, of a crystalline or sub-crystalline texture. The exposed surface is very hard and full of flaws, from long exposure, but by quarrying into the bed beyond the influence of surface agencies, an excellent material might be obtained, that would be adapted to various kinds of ornamental work, of uniform quality and texture, and susceptible of a high polish.

*Bald Knob* is a very prominent inland bluff or promontory, that lies a little to the west of the center of township 11 south, range 2 west, and appears to be mainly composed of the silicious limestones and chert of this formation. The cherty beds outcrop along its lower slopes, but the summit was so covered with soil and detritus that the highest rocks could not be seen. On its sides were seen tumbling masses of white quartzose sandstone, that appeared to belong to the bed usually overlying the Oriskany group in this portion of the State. It is said to be the highest elevation in the county, and it is probable its altitude is due to some local disturbance and uplift of the strata. Although the strata of the knob, itself, seem to lie nearly horizontal, we find the Lower Carboniferous beds, on its north side, dipping at a high angle to the northeastward. In the banks of Seminary Fork, on the southeastern side of the knob, we found the characteristic fossils of this cherty limestone quite abundant, and about half a mile further east, on the same branch, we found the overlying sandstone extending down to the creek level.

The characteristic fossils of this group, obtained from the exposures of the strata in this county, are the following: *Leptocœlia flabellites*, *Leptæna nucleata*, *Rhynchonella speciosa*, *Platyceras tortuosum*, *Rensselæria Condoni*, *Spirifer arctus?* and *Stricklandinia elongata*, var. *curta*.

*Quartzose Sandstone and Striped Shales.*—These beds, which have been considered as forming the uppermost strata of the Oriskany series, more probably belong to a higher geological level. They directly overlie the cherty limestones just described, but owing to the comparatively small thickness of strata, and the readiness with which the rock yields to the influence of atmospheric agencies, good exposures of it are rarely seen, and it exerts but little influence in modifying the topographical features of the surface in this county. The shales are much thinner here than in Alexander county, and in the central and northern portions of the county they were not met with at all. Four miles west of Jonesboro, on the road to Willard's landing, the sandstone is exposed near the foot of the bluff, and is directly overlaid by a massive gray limestone, equivalent to the Onondaga limestone of New York, without any intervening shales, so far as could be seen. The sandstone was not fully exposed at this point, but was at least thirty feet or more in thickness. We found at this locality a good many fossils, among which are the following: A small undetermined *Zaphrentis*, *Pleurodictyum problematicum*, an *Orthis*, like *O. musculosa*, a finely striated *Stophodonta*, like *S. magnifica*, but smaller, and fragments of a large *Odontocephalus*, similar to, but much larger than that from the overlying limestone. About two miles and a half southwest of Jonesboro, on the middle fork of Caney creek, the lower part of this sandstone is exposed, resting directly upon the thin bedded, silicious and cherty limestones of the Clear Creek group, without any indications of shale between. The thin bedded limestone was full of the characteristic fossils of this group, at this locality, and a few were also obtained from the sandstone. The latter is most commonly met with on the summits of the chert hills, or in tumbling masses on their slopes. Three and a half miles southwest of Jonesboro, it outcrops on the south fork of Caney creek, and at one locality in this neighborhood, where it is of a pure white color, it has been mistaken for marble. It is usually more or less stained with the red oxyd of iron, the colors being similar to those of the striped shales that are sometimes associated with it.

The striped shales, or "Calico rock," occurs in the south part of the county, especially on Miners' creek, where, according to Mr. ENGELMANN, there is a thickness of about fifty feet of these shales expesed, passing upward into chert. It is quite probable that the sandstone and shale replace each other, as the shales are sometimes seen below the sandstone, and at other localities above it, these changes being due to the fine or coarse character of the sediment; the finer giving origin to the shales, and the coarser to the sandstone.

*Onondaga Limestone.*—Above the sandstone and shale just described, there is a massive gray limestone, usually about twenty feet in thickness, which, from its peculiar group of fossils, we regard as the equivalent of the Onondaga limestone of the New York Reports. It is lighter colored, more massive and less cherty than the overlying limestones of the Hamilton group, and may thus be readily distinguished from them, even in the absence of characteristic fossils. This limestone outcrops two miles west of Jonesboro, on the road to Willard's landing, in the bed of the creek, and four miles west, on the same road, it is found directly overlying the sandstone and shale, which has already been described as forming the base of the bluff at this locality. This rock was supposed to form the base of the Hamilton series, until the fossils which it contained were critically examined, when it was found to be quite distinct from that, and more closely allied to the older divisions of the Devonian series. Its line of outcrop through this county is determined by the overlying Hamilton limestones, with which it is intimately associated. Its most characteristic fossils are *Centronella hecate*, *Spirifer acuminatus*, *S. fimbriatus*, several undetermined *Spirifers* with greatly extended hinge lines, *Atrypa reticularis*, a small *Productus*, like *P. subaculeatus*, and a species of the curious group of *Trilobites*, that also occurs in the underlying sandstone, resembling the *Odontocephalus selenurus* of the Corniferous limestone of New York, and it may be that this is the western representative of both the Onondaga and Corniferous limestone of the eastern States. At the most northerly outcrops of this limestone, in Jackson county, it becomes locally quite arenaceous, and consists, in part, of alternations of thin beds of limestone and sandstone, showing by its lithological, as well as its palæontological characters, a more intimate relation with the underlying than the overlying formation.

*Hamilton Limestone and Shale.*—The Hamilton group in this portion of the State consists of three divisions, which, in the ascending order, may be described as follows: First, dark steel-gray, silicious fœted limestone, containing more or less chert, in nodular forms, and also in seams with silicious fossils. Second, brown or chocolate-colored shaley limestone, passing into calcareous shale; and, third, gray, semi-crystalline or granular limestone, comparatively free from chert, and with the embedded fossils, in their original calcareous condition. These divisions are in their aggregate nearly a hundred feet in thickness, but are seldom well exposed in this county. About two miles northwest of Jonesboro, on the middle fork of Caney creek, the following section was made of these limestones and the overlying beds:

| | | |
|---|---|---|
| Variegated, silicious and cherty shales, with layers of chert | 100 | feet. |
| Black slate and argillaceous shales | 50 | " |
| Shale and argillaceous limestone, with some beds of granular gray limestone | 62 | " |
| Chocolate-colored and brown calcareous shale | 22 | " |
| Compact dark bluish-gray fœted limestone | 20 | " |

The three lower beds of this section I regard as representing the Hamilton group, of the New York series, and this conclusion is fully established by the specific character of the fossils they contain. The region over which this group outcrops in this county is very limited and is confined to a very narrow belt, extending through the eastern portion of townships 12 and 13, range 2 west, in a course a little west of north, from the southeast corner of township 13 south, range 2 west, and terminating near the Iron Mountain, on the northwest quarter of section 34, township 11 south, range 2 west. Among the fossils obtained from these beds, in Union county, are *Strophomena rhomboidalis*, *Calymene bufo*, *Tropidoleptus carinatus*, which is very abundant in some of the beds of gray limestone, a beautiful species of *Combophyllum*, several species of *Zaphrentis*, and some other undetermined corals. The lower portion of the group is strongly impregnated with bituminous matter, as is shown by its dark color, and the fœtid odor which it emits when struck with the hammer. Very possibly it represents the Devonian oil-producing zone of Canada, though no oil springs have been seen in Illinois in the vicinity of its outcrop.

*Black Slate.*—This division of the Devonian series is very well developed in this county, and attains a thickness of fifty to seventy feet, though it is seldom exposed in its full thickness. On Caney creek, about two miles north-west of Jonesboro, where the above section was observed, the bed was pretty well exposed, and on one of the ravines in this vicinity a drift had been carried into the hill, where it outcrops, in search of coal. From its close resemblance to the bituminous shales of the coal measures, it is not very surprising that those who are entirely ignorant of the fact that the workable coal beds are restricted to a certain geological horizon, and that this slate is far below that horizon, should suppose that its outcrop indicated the proximity of coal, and consequently be led into a useless expenditure of time and means, in a vain search after coal in regions remote from the true coal-bearing strata. Only a portion of the bed presents the color, the highly bituminous characters, and slatey cleavage, which suggested the name by which it is generally known in the west, and the remainder consists of green and blue, or chocolate-colored argillaceous shales, often so closely resembling the next succeeding formation that no exact line of division can be drawn between them at the partial exposures usually met with in this county. Its most northerly outcrop in this county is at what is called the Iron Mountain, where it forms the southeastern slope of the hill on the north-east quarter of section 34, township 11 south, range 2 west. From this point the trend of its outcrop is a little to the east of south to the south-east corner of section 36, township 13 south, range 2 west, making an easting of about two miles in a distance of thirteen miles from north to south. Besides the localities already given, the black slate outcrops on the north fork of Caney creek, on the south-west quarter of section 11, township 12 south, range 2 west. In the exposures of this horizon, west and south of Jonesboro, the bed becomes mostly argillaceous, and the black laminated slates were not seen, and are probably replaced by argillaceous shales. A single species of fossil shell was obtained from the slate at the point where the tunnel was carried into the hill, a mile or more west of Jonesboro. This was a *Lingula* apparently identical with the *L. spatulata* of the Genessee slate, of which these beds are supposed to be the western representative. This fossil is exceedingly abundant in Ohio and in Tennessee, wherever this strata is exposed, but it has as yet been found nowhere in Illinois except at the locality above named. This shell is figured on plate 13, figure 1.

*Silicious Shales.*—The Black slate formation is succeeded by a series of silicious and partly argillaceous shales, with some intercalations of chert, which are variously colored, sometimes striped, but usually brown, and attain a thickness of a hundred feet or more. Owing to the soft character of the material of which these shales are, for the most part, composed, good exposures are rarely met with, and the strata are generally covered up in the slopes of the hills. They have afforded no fossils to aid in the determination of their true horizon, but from their lithological characters, and their strati-

area about twelve miles in width. Its most northerly outcrop is on the Seminary fork of Clear creek, near the center of township 11 south, range 2 west, and on the head-waters of Clear creek, in the south-eastern part of the same township. In township 12 south, range 1 and 2 west, it outcrops on all the head-waters of Caney creek, and on Little creek, and over the whole of township 13 south, range 1 west, except a small area in the south-west corner of the township, on Big creek, throughout its whole course in this county, and on Add's branch, and Cypress creek, below the middle of section 23, township 12 south, range 1 east.

This limestone presents considerable variation in its lithological characters in the different parts of the formation, and also at different localities in the same stratum. The lowest portion of the group, which is tolerably well exposed a half mile west of Jonesboro, forms what is known in that region as the Jonesboro limestone. It it a massive, light gray, or nearly white, sub-crystalline, or earthy limestone, that breaks regularly into rectangular blocks, and forms a good and durable building stone. Most of it, at the outcrops we examined, is quite free from chert, but, locally, it becomes somewhat cherty, the silicious material being disseminated through it in concretions, or in fine particles, which, when the lime is dissolved, leaves a skeleton of porous chert. The thickness of this part of the group, exposed near Jonesboro, is about thirty feet, but probably in the aggregate it is much more. It has afforded no well defined fossils, and its true age is only determined by its stratigraphical position and its lithological characters, which appear to be more nearly related to the St. Louis group than to any other division of the Lower Carboniferous series. The principal outcrops of this rock in this county, besides the one just named, immediately west of Jonesboro, are on Caney creek, near the center of section 11, township 12, range 2, at the German meeting house, in the center of section 1, township 13, range 2 west, thence up the branch in the south-east quarter of section 1, the north-east quarter of section 12, and through the south half of the adjoining section 6. On the branches of Mill creek it outcrops near the south-east corner of section 13, township 13, range 2 west, and in the south-west corner of section 18, township 13, range 1 west, in the south-east quarter of section 17 and the north-east corner of section 19, and through the south-west quarter of section 20, from whence it probably extends southward to the county line. The curious forms known under the names of *epsomites*, *crystalites*, *stylolithes*, *lignilites*, etc., are frequently met with in this part of the St. Louis group, near Jonesboro. They consist of portions of the rock that are separated from the surrounding mass by a series of parallel columns, or flutings, which penetrate the strata at right-angles to the plane of stratification, and give to the inclosed mass, when broken out, a virtically striated surface. Their origin has been explained in various ways, and as fossil shells are often found, forming one extremity of the *lignilite*, determining to some extent their size and form, it has been sug-

four or five different bodies of limestone, separated by sandstones and shales, and is characterized by a distinct group of fossils, which serve to distinguish it at once from any of the subordinate groups of limestone. Eight divisions of this group have been recognized in Union county, four of which are limestones, and the remainder sandstones and shales, and we have numbered them consecutively from the top downward; the odd numbers, 1, 3, 5, 7, being applied to the limestones, and the even numbers, 2, 4, 6, 8, to the sandstones.

The limestones of this group are usually argillaceous, sometimes silicious and ferruginous, and are readily distinguished from the other calcareous divisions of the Lower Carboniferous series, even in the absence of characteristic fossils, by their lithological characters. The sandstones are more evenly and thinly bedded than the overlying conglomerate, and are locally ripple-marked. The lowest division of this group is a thick bed of sandstone, to which the name of ferruginous sandstone has sometimes been applied, from the ferruginous matter which it contains at certain localities. This character predominates more or less in all the sandstones of this series, the brown oxyd of iron being generally disseminated through it in specks, giving a mottled appearance to the rock when freshly broken. Locally the upper standstones of this series are replaced by shales, either argillaceous or sandy, and as they readily decompose when exposed to atmospheric action, they are usually covered up in the slopes of the hills. The thickness of the lower sandstone, No. 8, of this series is about 150 feet in this county, and commencing on the head waters of Huggins' creek, in the north-west part of the county, its line of outcrop extends in a nearly due south-east course to the middle of the east line of township 13 south, range 1 east, where it crosses the county line into Johnson county. On the Seminary fork of Clear creek, in the north-west quarter of section 22, township 11 south, range 2 west, it may be seen rising abruptly to the surface, with a strong dip to the north-east, and forming the base of a heavy limestone series. It may be seen capping the St. Louis limestone near the north-west corner of section 26, and on the main fork of Clear creek, above the Iron Mountain, and probably crosses the dividing ridge in the north-east quarter of section 6, township 12 south, range 1 west. On a branch of Cache river, on the south-east quarter of section 8, it was traced for some distance, until the creek turns east, when it dips below the water level, and is succeeded by the higher members of the series. On Big creek, as far as it runs south-eastward, this sandstone caps the ridge to the north-east, and continues in that course by the head of Add's branch, and crosses Cypress creek, striking the Johnson county line at the south-east corner of section 24, township 13 south, range 1 east.

It is better exposed on Cypress creek than anywhere else in the county, and beginning in the breaks at the head of the creek, on the south-east quarter of section 23, township 12 south, range 1 west, it outcrops along the creek for some distance, forming not only its banks, but the slopes of the adjacent hills.

A portion of it here is thinly bedded, and separates into thin, even slabs, suited to various building purposes. On the north-east quarter of section 31, township 12 south, range 1 east, it crops out along a small branch of this creek, and is fine-grained, white, with brown spots, purely quartzose, and rather soft when first quarried, but hardens on exposure. It is obtained here in fine, even slabs, from one to twelve inches in thickness, which dress easily, and appear to possess a suitable grit for grindstones, and is also suitable for foundation walls, and many other uses for which building stones are required. These evenly-bedded layers are not confined in their outcrop to this locality, but have been observed at several points in this county. In the north-west quarter of section 32, the upper shaley strata of this division are exposed at the foot of hills on the north side of the creek, while the overlying limestone outcrops higher up on the slope. In the south part of section 33, the sandstone reaches a hight of sixty or seventy feet above the creek, and is overlaid by the succeeding limestone. From thence down the creek, it forms high cliffs a hundred feet or more in hight, down to section 3, township 13, range 1 east, where the course of the creek changes more to the eastward, and the sandstone dips below the creek level, except some shaley layers that form the the top of this division, and continue near the creek level lower down, even where the overlying limestone forms the main portion of the bluff. The sandstone rises again on section 12, and from thence down, it forms a continuous and gradually rising bluff to section 24, where it leaves the creek in consequence of the south-westerly direction of its course.

The outcrops of the upper members of this series cannot be so accurately traced, in consequence of the general resemblance which the different beds bear to each other, and for the lack of continuous exposures along the line of trend of the strata. The area which they occupy in this county may be briefly described as follows: Commencing in the south-eastern portion they outcrop in the north-eastern corner of township 13 south, range 1 east, over the whole of township 12 south, range 1 east, except the south-west corner. The southern part of township 11 south, range 1 east and 11 south, 1 west, extending up Bradshaw's creek, to within a mile of the northern line of the county, and outcropping on Drury's creek, nearly as far north; and in township 11 south, range 2 west, they form a belt about two miles in width, extending diagonally from the south-east to the north-west corner of the township. They also outcrop on the north side of the dividing ridge in this township, on the head-waters of Clay-lick, Cedar and Cave creeks, to the north line of the county. From these remarks it will be seen that the general trend of these strata corresponds very nearly with that of the St. Louis limestone below, and is very nearly from north-west to south-east.

The following section of the lower portion of the group was made by Mr. ENGELMANN, on Cypress creek, on the south part of section 33, township 12 south, range 1 east:

| | |
|---|---|
| Covered slope at top of the hill, not measured | |
| Massive sandstone, partially exposed | 20 feet. |
| Close textured gray limestone, with *Archimedes* and other fossils | 40 " |
| Hidden slope, probably underlaid by limestone or shale | 18 " |
| Limestone, similar to that above | 21 " |
| Limestone, close textured and crystalline, bluish or brownish gray, with *Archimedes*, *Productus elegans*, etc | 19 " |
| Sandstone, mostly fine grained and quartzose, some of it thin bedded, and in the upper part shaley | 70 " |

It is probable that all these limestones, including the hidden slope between the two sandstones, belong to the lower limestone division, No. 7, of the Chester series; and if so, it is about one hundred feet in thickness in this part of the county. This limestone forms the principal part the bluffs on Cypress creek, in sections 2 and 12, and near the mouth of Dry Fork, in the west part of section 2, it forms a prominent bluff, where a hundred feet in thickness of the limestone is exposed. The same strata outcrop on the Vienna road, near the bridge, in the south-east quarter of the same section, where the limestone shows intercallations of argillaceous shales. Near the middle of section 12, township 13, range 1 east, the limestone is overlaid by forty feet of sandstone. The only point where this limestone was seen extending to the south-west, beyond Cypress creek, is on section 11, and it is no doubt the lower limestone, or No. 7, of the Chester series, reckoning from the top downwards. This limestone also outcrops to the north-westward, on a branch of *Cache* creek, north-east of Anna, on the south-west quarter of section 9, township 12 south, range 1 west, where from sixty to eighty feet in thickness of it may be seen, and it extends across the hills into the south-west quarter of section 9, and thence diagonally across section 16, dipping strongly to the north-east. The exposed portions are mostly gray and crystalline, with numerous fossils, and especially *Pentremites godoni*, *Productus elegans*, *Spirifer lineatus*, *Athyris ambigua*, and *Archimedes*. Beyond this point, on the west half of section 9, we find the overlying sandstone, No. 6, forming a bluff about forty feet in hight, and at another point in the north-west quarter of the same section, the following section was made, where nearly the whole thickness of this sandstone was exposed:

| | |
|---|---|
| Vertical cliff of sandstone | 10 feet. |
| Slope, underlaid with thin beds of sandstone | 24 " |
| Hard sandstone, in thin beds, alternating with shales | 10 " |
| Gray and purple argillaceous shales | 10 " |

The underlying limestone, No. 7, crops out near by, and this section probably shows very nearly the whole thickness of the sandstone, No. 6, which is here not far from sixty feet. In section 34, township 12 south, range 1 east, there is from twenty to thirty feet of this sandstone exposed in thin and evenly stratified beds. Continuing up the eastern branch of this creek, to the north-east quarter of section 34 and the north-west quarter of section 35, we find the overlying limestone, No. 5, capping the ridge. It is also exposed on the north-east quarter of section 1, township 13 south, range 1 east, and the adjoining section 36, on the north. In the northern part of township 12 south, range 1 west, these rocks are also well exposed in numerous outcrops, on the branches of Cache river. On the south-west quarter of section 4, the sandstone, No. 6, appears, dipping rapidly down the creek, and soon disappears and is succeeded by the limestone, No. 5, and that by the overlying sandstone, No. 4. The limestone, No. 5, may be traced to section 9, where it is much better exposed. The overlying sandstone caps the ridge in the north-east quarter of section 9, and in the west part of section 10, and forms the bluffs of the creek on the south-east quarter of section 4, and through sections 3 and 2. On the south-west quarter of section 3, it is exposed from the water's edge to the hight of forty feet, mostly in thin beds, suitable for building material.

On a sharp southward bend of the creek in section 2, near the east line, and just above the crossing of the Jonesboro and Saratoga road, this limestone, No. 5, outcrops on the south bank of the creek, forming a bluff twenty feet in hight, above a sloping bank of twelve feet, and it is here overlaid by twelve feet of sandstone, above which was a ledge of brown limestone, (containing the remains of *Fishes and Trilobites,*) which appeared to be a local intercalation in the sandstone, loose masses of which covered the slope above. In the northwest quarter of section 1, the sandstone forms the banks of the creek, and the stratum of intercalated limestone is again seen two feet in thickness, containing the fossils common to this group. The sandstone, No. 6, also appears on Cache river, on section 17, township 12 south, range 1 east. The lower part, about twenty feet in thickness, is thin bedded, fine grained and of a dark-brown color, and some portions of it are very hard, approaching a quartzite in texture. The upper part is best exposed a short distance farther east, in the north-east quarter of section 20, where the creek runs over thin beds of ripple-marked, brown, compact, flinty sand-rock, that split regularly into rhomboidal slabs, and show a strong dip to the north-north-east. Above it, there are about ten feet of gray argillaceous shales, the upper eight inches of which are dark-colored and bituminous, and contain, in the upper two inches, some thin streaks of coal. This stratum has been observed at several other points in this and the adjoining counties, and indicates the earliest period when the coal-forming conditions began to prevail in southern Illinois.

Sandstone No. 4, is only exposed on Cache river, on the south-east quarter of section 14, where it is seen as a finely-grained, compact, brown, slightly micaceous sandstone, capped by the limestone No. 3, and it also appears on the lower course of Bradshaw's creek, in the north-east quarter of section 16. Except at the point above named, the Chester limestone, No. 3, was not seen on Cache river, except near the Johnson county line, on the south-east quarter of section 13, where ledges of it cross the creek, and the water has worn a narrow channel through the rugged masses of limestone. It is of a bluish-gray color, close-textured, with an uneven fracture. Half a mile to the north-east of this point, on the south-west quarter of section 13, it is again exposed in the lower part of the bluff, about thirty feet in thickness, while the sandstone No. 2 caps the bluffs, which are abruptly broken. To the northward the sandstone extends to the lower part of Lick creek.

On Bradshaw's creek, which heads in the dividing ridge that traverses the northern part of the county, there are numerous outcrops of this limestone, beginning a half mile above its junction with Cache river, and extending northward nearly to the township line. It is usually of a dark bluish-gray color, fœtid, hard and subcrystalline, and contains the common fossils of the group. The overlying sandstone No. 2 crops out on sections 2 and 3, township 12 south, range 1 east, while in the north-west quarter of section 3, the upper limestone No. 1 is seen. On the north-west quarter of section 32, township 11 south, range 1 east, the limestone No. 3, is seen rising from twenty-five to thirty feet above the water level, and is here overlaid by ten feet of shales, and a heavy body of sandstone, which forms prominent cliffs in the bend of the creek on the north part of section 31. Extending thence westward, it caps the highest ridges north-east of Saratoga. On the north-west quarter of section 30, the sandstone dips below the creek level, and is succeeded by the upper limestone, which outcrops along the upper course of the creek, nearly to the north line of the county. On Lick creek and Conneway branch, this limestone is well exposed, and on the former creek reaches nearly the head, attaining a thickness of a hundred feet or more, and is succeeded by the conglomerate.

West and north-west from Saratoga, on the branches of Cache river, these two upper divisions of the Chester series form the principal outcrops, extending to Cobden, and on the head waters of Drury's creek, to within about a mile and a half of the north line of the county.

On the head waters of Clear creek, west and north-west of Cobden, the lower divisions of the Chester series appear, forming prominent bluffs on section 25, township 11 south, range 2 west, and they also appear on some of the head branches of Huggins' creek, and on Cave creek, Cedar creek, and Clay-lick creek, on the northern side of the dividing ridge. The aggregate thickness of the group in this county probably will not exceed seven or eight hundred feet, and as it is somewhat irregular in its development, it would be found to vary considerably in its thickness at different points.

The upper limestone division, which reaches an aggregate thickness in this county of more than a hundred feet, according to the measurements and sections of Mr. **Engelmann**, includes beds which, in some of the adjoining counties, probably constitute two or three distinct divisions of the series. The prevalence of quartzose sandstones through the group, seems to ally it somewhat closely to the overlying Conglomerate, and indeed the whole series was included by Dr. Owen with the Conglomerate, as constituting the series equivalent to the Millstone-grit of England. But the presence of *Pentremites*, *Archimedes*, and many other fossils which are everywhere considered as characteristic Lower Carboniferous forms, has caused it to be recognized latterly by nearly all American Geologists as the upper division of the Lower Carboniferous limestones.

*Conglomerate.*—This sandstone, which forms the base of the true Coal Measures, and, locally, contains some beds of coal that reach a thickness of two or three feet, and are consequently of some commercial value, outcrops over a considerable area in the north-western portion of the county, and its southern limit is pretty nearly defined by the dividing ridge which we have already mentioned as traversing the northern portion of the county, and forming a distinct water-shed across the southern portion of the State. The base of this formation consists of a massive quartzose sandstone, usually coarse-grained, and, locally, containing embedded pebbles from the size of a pea upward to several inches in diameter. Its outcrop often presents, at the base, a perpendicular face of concretionary or imperfectly stratified sandstone, fifty feet or more in thickness. Above this, the beds become more evenly stratified, and are sometimes shaly, or interstratified with shales. Its thickness has not been accurately measured, but it probably reaches an average of two hundred feet or more. The most westerly outcrop of this formation in Union county, is in the south part of section 9, township 11 south, range 2 west, a little north-east of *Bald Knob*. From there it trends south-east to Cobden, where it is intersected by the water-courses of the South Pass, beyond which it continues to the south-east, nearly to the middle of section 33, township 11 south, range 1 west, where it bends abruptly to the northward, around the heads of Bradshaw's creek and Little Grassy, to within about a mile of the north line of the county, where it turns again rapidly south-eastward, in a narrow tongue, occupying the hills between Bradshaw's creek and Lick creek, as far south as the south-west quarter of section 28, township 11 south, range 1 east. On the north and east of Lick creek, it occupies the whole remaining area of the township, intersecting the Johnson county line at the south-east corner of township 11 south, range 1 east. Its outcrop in the county covers an area of a little more than one and a half townships, and is confined to the northern and north-eastern portions of the county. A few plants, such as *Sigillaria*, *Stigmaria*, *Lepidodendron*, etc., have been found in the evenly bedded sandstones of this group, on Drury's creek, and these are the only fossils it has thus far afforded.

*Superficial Deposits.*—The surface deposits upon the uplands in this county, consist mainly of a yellow, loamy clay, mixed, locally, with flinty gravel, derived, no doubt, from the underlying limestones, by the decomposition of the calcareous portions, through atmospheric agencies; but no evidences were seen of the presence of anything like true Northern Drift in the county. The Loess formation was recognized at a single locality only, on the road from Jonesboro to Willard's landing, where the road intersects a ridge of this material on the eastern side of the Mississippi bottom, and the cut through it exposes from 20 to 30 feet of light, buff colored, finely arenaceous silt, in situ, and presenting the usual appearance of the arenaceous beds of this formation. And it is worthy of remark, that in this region no deposits of this kind cap the highest hills, as at more northerly localities, but, they occupy the valleys, showing that the hills in this part of the State were already elevated far above the water level at the time the Loess beds were deposited. These beds extend downward very nearly or quite to the present level of the Mississippi bottoms.

## *Economical Geology.*

*Coal.*—From what has already been said in the foregoing pages, it will be seen that there are no true coal-bearing rocks in this connty, and hence, that no reasonable expectation of finding extensive deposits of coal can be entertained. As has already been said, considerable labor has been expended west of Jonesboro, in digging for coal in the Black slate of the Devonian series; but as this slate lies more than a thousand feet below the horizon of any true coal bearing strata, the labor and means so expended can only result in disappointment. There are some thin streaks of coal, appearing, locally, interstratified with the shales of the Chester series; but they have never been found so developed as to be of any practical value. One of the thin coals, occurring in the Conglomerate, has been found just over the county line, in Williamson county, and may possibly extend into Union, and if so, will be found near the north line of the county. This is the only portion of the county where coal may be looked for with any prospect of success, and it is but seldom that the Conglomerate coals are sufficiently developed to make them of any practical value, except to supply the immediate neighborhood where they outcrop.

*Iron Ore.*—The brown hematite ore exists in this county in considerable quantities, though to the present time no deposit has been discovered that appears to be sufficiently extensive, and free from extraneous matter to justify the erection of a furnace. The principal deposit of this kind, and the only one that promises to be of any practical value, is that already partially described as forming the summit of the ridge known as the Iron Mountain. The ore is a good, compact variety of brown hematite, which, in its purest state, affords from fifty to sixty per cent. of metallic iron, but it is here more or less intermingled with chert, the latter often forming the greater portion of the mass. No considerable body of ore was seen during our examinations of this region, that was entirely free from silicious matter, and this would necessarily very much deteriorate the value of the ore for the manufacture of metallic iron. It is quite possible however that a more careful search, by digging into the cherty mass at the most prominent points, would bring to light an accumulation of the ore so free from chert as to be successfully smelted for the production of iron. The ore and chert with which it is associated, forms the summit of the ridge, while the slope of the hill is formed by the shales and slates of the Devonian period, underlaid by the fœtid limestones of the Hamilton series. As these beds are no where highly ferruginous, it is not probable that the iron originated in them, but rather from some limestones of Lower Carboniferous age, which no doubt originally extended over the ridge. These limestones may have been the source of Chalybeate springs, from which the iron was precipitated as the water reached the surface and dissolved the lime, leaving the chert to be embedded as we now find it, in a ferruginous mass. The dip of the Lower Carboniferous limestones now found to the north-eastward of this ridge, is such, that any considerable extension of their beds to the south-westward would carry the strata to the summit of this ridge, of which they no doubt once formed a part, and from which they have been removed by erosion at some comparatively recent period. In some respects this deposit resembles the ferruginous conglomerate of the Tertiary that occurs along the Ohio river, in Pulaski and Massac counties, and it is possible that it may be of the same age, and owe its origin to a similar cause.

Near the top of the ridge excavations have been made before the present settlement of the country, perhaps by the Spaniards or the old French inhabitants, who no doubt carefully explored such portions of the country as seemed likely to afford valuable deposits of metallic ores. This iron ore shows itself on the southern extension of the Iron Mountain ridge in the north-east quarter of section 3, township 12, range 2 west, and also on the north side of Clear creek, in section 27, township 11, range 2, thus showing that it originally extended over a considerable area.

*Lead Ore.*—The sulphuret of lead, or *galena*, has been found in small quantities in the cherty limestones of the Devonian series. On Huggins' creek, on the south-west quarter of section 1, township 11, range 3 west, it has been found near Mr. Gregory's. The galena occurs here, associated with calc-spar, filling small pockets in the rock. Altogether about one hundred pounds of the mineral was obtained at this locality. It is possible that a pocket might be found that would yield a considerable quantity of ore, but the prospect is not encouraging for successful mining operations.

*Potter's Clay.*—Good potter's clay occurs at several localities in Union county. On the north-west quarter of section 2, township 12 south, range 2 west, a very fine white pipe clay is found, which is used at the pottery in Anna, for the manufacture of common stone-ware, by mixing with a common clay found near the town. This pipe clay is nearly white in color, with streaks of purple through it, and appears from its colors to have been derived from the striped shales known locally in this part of the State as "Calico Rock." Except for the coloring matter which it contains, this clay seems to be of a quality suited for the manufacture of a fine article of white ware. On the eastern slope of *Bald Knob* a fine silicious clay is found, similar in appearance to that forming what is known as the *Chalk Banks*, on the Mississippi, which has resulted apparently from the decomposition of the cherty beds of the Oriskany group. The striped clay first mentioned, has been found at several localities in this county, and will no doubt prove to be a valuable deposit. Specimens have been collected for analysis, and its constituents will soon be accurately detertermined.*

*Building Materials.*—Building stones of excellent quality and in great variety, abound in this county. Sandstones of excellent quality occur abundantly in the arenaceous divisions of the Chester group, and especially in the lower division, which is here more than a hundred feet in thickness. The rock is generally firm in its texture, and the oxyd of iron which it contains acts as a durable cement, and renders it a very reliable stone, not only for dry walls, but for culverts and bridge abutments, where it will be subject to the combined action of frost and water. It is sometimes thin bedded, and affords slabs suitable for flags. At other localities it is more massive, and readily splits into blocks suitable for dimension stone. But all sandstones required for heavy masonry, and especially where they are required to resist the combined action of frost and water, should be selected with care, and always from that portion of the quarry where the exposed ledges are not seriously affected by exposure to atmospheric agencies. The Conglomerate sandstone is generally less coherent in structure than the sandstone of the Chester series, and is far less reliable as a building stone, but occasionally it is found in regular beds, and sufficiently firm in texture for ordinary building purposes.

The St. Louis limestone affords a good building material, especially the upper and lower divisions. At the quarries a half mile west of Jonesboro, the rock is a massive, nearly white limestone, free from chert, and dresses well, and in a dry wall will probably prove to be durable, but splits when used for curbing, or wherever it is subject to the action of frost and water. The middle of this division is a dark gray, cherty limestone, that might answer well for rough walls, but would not dress well in consequence of the cherty matter so generally disseminated through it. The upper division, quarried east of Anna, is a light gray, massive limestone, tolerably free from chert, and in quality similar to the quarry rock a half mile west of Jonesboro. The Chester limestones, when not too argillaceous in their character, afford good building stones, and the dark blue, semi-crystalline limestone in the vicinity of Cobden, which forms the upper division of the series, affords a good material for heavy work, and has been used for culverts at several points along the Central railroad.

*Limestone for Lime.*—The best limestone for the manufacture of quick lime, is found in the upper portion of the St. Louis group, and is extensively quarried a half mile east of Anna, where several kilns are constantly in operation. The rock is a crystalline, and partly oolitic, light gray limestone, nearly a pure carbonate of lime in its composition, and makes a fine white lime, similar in quality to the Alton lime, made from the same formation. The Cairo market, and the several towns along the Illinois Central railroad, are mainly supplied with lime from this locality. This vicinity could easily supply the wants of southern Illinois with this indispensable article. It is probable, also, that some of the limestones of the Devonian series might be made available for the manufacture of lime, but they seem to be more silicious in their composition than the limestone near Anna, and are, furthermore, not so easily accessible. The limestones of the Chester group, at many points are suitable for the manufacture of good lime, and there are many localities in that portion of the county where they outcrop, where lime can be conveniently and cheaply made. The lime made from these beds, however, is not equal to that obtained from the St. Louis limestone, being of a yellowish color, and some of the beds do not slack well when burned.

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*For an analysis of these clays see appendix to this volume.

Marble.—The variegated limestones occurring at the base of the Lower Helderberg series have already been described in the report on Alexander county, and their adaptation to the various uses for which an ornamental stone is required has been briefly discussed. These limestones, presenting similar lithological characters, were observed at the base of the bluff near the point where the road from Clear creek, leading to Jonesboro, strikes the river bluff, two miles from the south line of the county, and they will no doubt be found at many places in this vicinity. The variegated beds appeared to attain a thickness of about twenty feet at this locality, and pass gradually into the silicious limestones above. The Clear creek limestone, of the Devonian series, also affords at some localities heavy beds of nearly pure white, or delicate grayish white, crystalline limestone, that is susceptible of receiving and retaining a high polish, and seems to be well adapted to the use of the marble worker. These occur on Hutchins's creek, on sections 22 and 14, and also on the northwest quarter of section 23, township 11 south, range 3 west. The rock weathers somewhat unevenly, giving a flawed appearance to a long exposed surface; but by quarrying into the bed beyond the influence of surface agencies, a sound and excellent marble would no doubt be found. These outcrops are from eight to ten miles distant from Cobden, on the Central railroad, and three or four miles from the Big Muddy river. The beds are no doubt the equivalents of those at *Bald Knob* and the lower end of the *Back-bone*, in Jackson county, to be described in the following chapter.

Clay for brick, and Sand for mortar, can be found in almost any neighborhood in the county. The common brown clays of the subsoil in this county make good brick, and sand is found in all the alluvial deposits along the streams, and especially where sandstone is the prevailing rock.

Bur-stone.—The cavernous masses of chert rock contained in the Clear creek limestones, affords at some points, a bur-stone that appears to be nearly, if not quite equal in quality to the celebrated French bur-stone, so extensively used for mill-stones in this country. Some of the specimens obtained here seem to possess the requisite hardness and porosity, and some mill-stones have been obtained from the chert beds at *Bald Knob*, that are said to have answered a good purpose and were used in the neighboring mills. But these were made from the rock that had been long exposed at the surface, and perhaps were not taken even from the best part of that; while the beds lying beyond the reach of atmospheric influences have not been tested. For grinding corn, these home manufactured stones have answered a good purpose, doing their work rapidly and well. For grinding wheat, their value has not yet been fairly tested.

*Grind-stones.*—Some of the evenly bedded sandstones of the Chester group, and especially the lower bed of the series, is frequently developed in thin, even layers, that could be readily manufactured into grind-stones. The rock has a fine, sharp grain, and if too soft when freshly quarried, would probably harden sufficiently on exposure to give them the necessary durability. Some beds of the Conglomerate sandstone also have a sharp grit, and when sufficiently compact in texture and even bedded will make good grind-stones.

*Mineral Springs.*—At *Western Saratoga*, in this county, there is a mineral spring in the Chester limestone, which has attained some celebrity in the surrounding country for its medicinal properties. It is located in the north-east corner of section 1, township 12 south, range 1 west, and appears to be a tolerably strong sulphur water, and contains, besides sulphuretted hydrogen, a small quantity of sulphate of lime, carbonate of soda, chloride of sodium, and perhaps a little alumina and magnesia. The water is said to be a specific for dyspepsia and chronic diseases of the skin. It is also said to be beneficial in cases of scrofula. The water is strongest during the dry season of the year, being then less affected by the admixture of surface water.

Near Seminary fork of Clear creek, on the south-west quarter of section 22, township 11 south, range 2 west, a strong spring boils up, from which bubbles of gas, probably carbonic acid gas, rise continually. The water does not appear to possess any decided mineral properties, but evidently originates from a deep source, as it preserves an even temperature throughout the year. The strata are strongly tilted in this vicinity, and this spring appears to rise to the surface through the fissures, formed by the disturbing cause that elevated the underlying rocks.

*Agriculture, Soils, etc.*—The topographical features of this county are quite varied, and are determined by the outcrops of the different geological formations within its limits. A tract of alluvial bottom land, from two to three miles in width, stretches along the western borders of the county, through its whole extent, and some quite narrow bottoms are also found on the lower courses of some of the largest creeks. In the very broken region where the Lower Helderberg and the Clear creek limestones outcrop, the arable land is restricted almost entirely to the creek vallies. The region underlaid by the Lower Carboniferous limestone series, although somewhat hilly, is nevertheless generally susceptible of cultivation, and constitutes the best grain-growing section of the county. The sandstones, limestones and shales forming this series, from the decomposition of which the soil has been formed, contain all the essential mineral ingredients necessary to the production of a soil physi-

[illegible] necessary [illegible] indispensable [illegible] more [illegible] water. [illegible]

[illegible]

[illegible] almost [illegible] in this [illegible] But the squatter [illegible] Illinois Central railroad [illegible] region, they [illegible] north of the Ohio river, [illegible] an abundant crop. Hence, the attention of fruit-growers was naturally drawn to this region, now brought within a day's travel of the Chicago market; and the result has been that these lands, which, in 1852 were not considered worth the government price of a dollar and a quarter an acre, are now readily sold at from $150 to $200 per acre, and are owned and occupied by the most intelligent and refined rural population that can be found in the west. This is undoubtedly the finest fruit region in the State, and more fruit is annually shipped from Cobden than from any other station on the road, and the annual products of the orchards and vineyards of this county must steadily and rapidly increase for years to come.

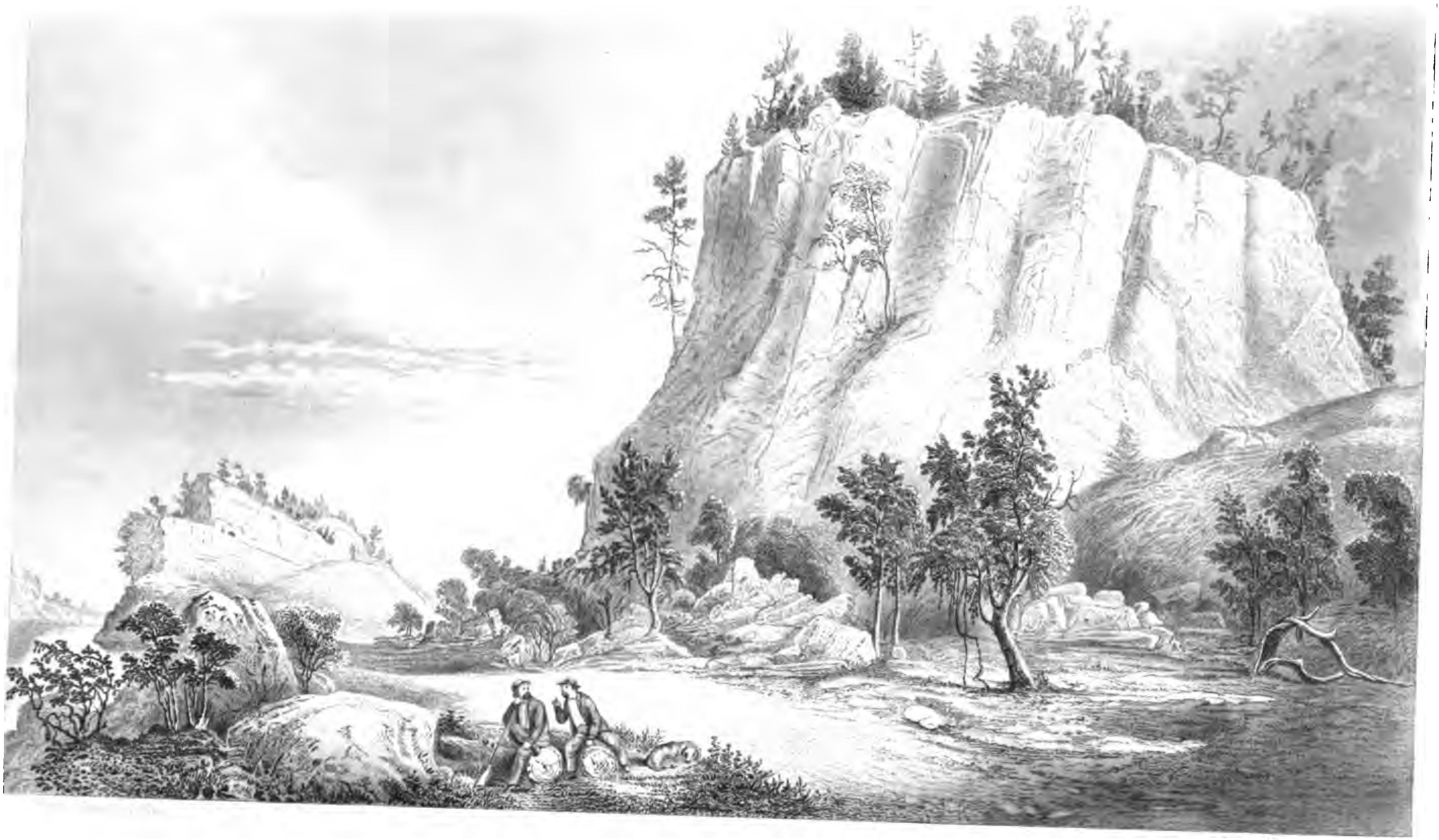
# CHAPTER IV.

## JACKSON COUNTY.

This county lies immediately north of Union county, which forms its southern boundary, and on the east it is bounded by Williamson and Franklin counties, on the north by Perry county, and on the west by Randolph county and the Mississippi river. It embraces an area of about five hundred and eighty square miles, of which something over one hundred is alluvial bottom land on the Mississippi. The county line which separates this county from Randolph on the north-west, runs from north-east to south-west, along the dividing ridge between Kinkaid creek and Mary's river. This county reaches north-eastward to the borders of the prairie region, and embraces two or three small prairies within its limits, while the remainder of the county was originally covered with a heavy growth of timber.

The bottom lands along the Mississippi are in part low and wet, while other portions are sufficiently dry to admit of cultivation, and are very productive, though subject to overflow during the annual spring floods. Some of the low lands are too wet for the growth of arboreal vegetation, and are covered with coarse grass and ponds of water. The higher parts of the bottoms are covered with a heavy growth of timber, among which we observed the following species: Willow, sweet-gum, tupelo-gum, sycamore, cotton-wood, honey locust, hackberry, box-elder, red birch, white ash, black ash, red oak, swamp or pin oak, swamp white oak, bur oak, white walnut, black walnut, pecan, horn beam, persimmon, red haw, mulberry, scaly-bark hickory, red and white elm, white and sugar maple, red bud, dogwood, pignut hickory, scarlet oak, linden, beech, white oak, black oak, black gum, yellow poplar, or tulip tree, etc.

The country adjacent to the river bluffs is roughly broken and hilly, and the bluffs themselves often present high rocky precipices, rising in bold relief from the river bottoms to the hight of two or three hundred feet, and form a bold and picturesque scenery. The main chain of bluffs is about five miles from the river, with a broad belt of bottom land intervening, but in the extreme south-western part of the county there is another range of bluffs immediately at the river bank, formed by some isolated hills that have success-



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UPPER END OF THE BACK BONE & BAKE OVEN-ON THE LEFT.

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fully withstood the denuding forces which excavated the broad valley now in part occupied by the Mississippi river. These hills are known as "Fountain Bluff," "Devil's Bake Oven," and "Back-bone," and the two latter are formed by an uplift of Devonian strata, which are here tilted to an angle of about 25°, dipping to the north-eastward, while the former consists in part of Chester limestone and sandstone, overlaid by the Conglomerate, with a very moderate dip in the same direction.

To illustrate the peculiar scenery in this part of the county, we directed some sketches to be made by Mr. PAULUS ROETTER, which was done in his usual excellent style, and these have been engraved on steel by the Western Engraving Company. The frontispiece, plate A, is a view of the Devonian strata at the "Bake Oven," looking north. Plate B is a view of the same beds forming the northern extremity of the "Backbone" looking north, with the "Bake Oven" on the left, and plate C a view of the same looking south. Plate D is a view of the southern extremity of the "Back-bone" looking north, showing the cherty beds of the Oriskany group, with tumbling masses of the overlying limestone.

*Fountain Bluff* or "*Big Hill*," as it is sometimes called, is an oval-shaped eminence, about three miles in length, from north to south, and about one mile and a half in width. Its base is formed of the Lower Carboniferous limestone of the Chester series which outcrops around its western and southern slope, and its upper part by the Conglomerate, the lower layers of which, at the northern extremity of the hill dip below the level of the adjacent bottom, while the higher beds form an elevation of two hundred feet or more above the river level. Between the lower end of this hill and the "Bake Oven," there is an interval of half a mile or more of bottom land which, before the erosion of the river valley, was no doubt occupied by the Lower Carboniferous and Devonian strata that properly intervene between the beds now outcropping at the "Bake Oven" and the southern extremity of Fountain Bluff.

Between these hills which now skirt the eastern shore of the Mississippi, and the regular chain of river bluffs which skirt the bottom lands on the east, there exists a broad belt of low, wet bottom, five miles in width, and mostly covered with ponds of water, except in the very dryest portions of the season, and over which for countless ages rolled the mighty currents that formed the valley in which the turbid waters of the Mississippi now find their way to the gulf. From the fact that the waters of the Mississippi are restricted to an area much less than its average width, at what is called the *Grand Tower*, and are hemmed in by precipitous limestone bluffs on either side, the theory has been entertained that at a former period these limestone cliffs extended quite across the river, forming an immense fall which has been gradually cut away by the current of the river; but the ingenious author of this apparently plausible theory was probably not aware of the existence of a valley five miles in width, within a half mile of the eastern bank of the river, through which the surplus water of the river now flows during every period of high water, and into which the whole current of the river would be turned by the introduction of any considerable impediment into its present channel. The whole valley, including the narrow gorge in which the river now runs, was formed long before the existence of the present river, and by causes far more potent than an ordinary river current, and was probably effected during a former submergence of the entire region, by the combined force of sub-aqueous currents and moving ice; the same agencies which have excavated all our principal river vallies.

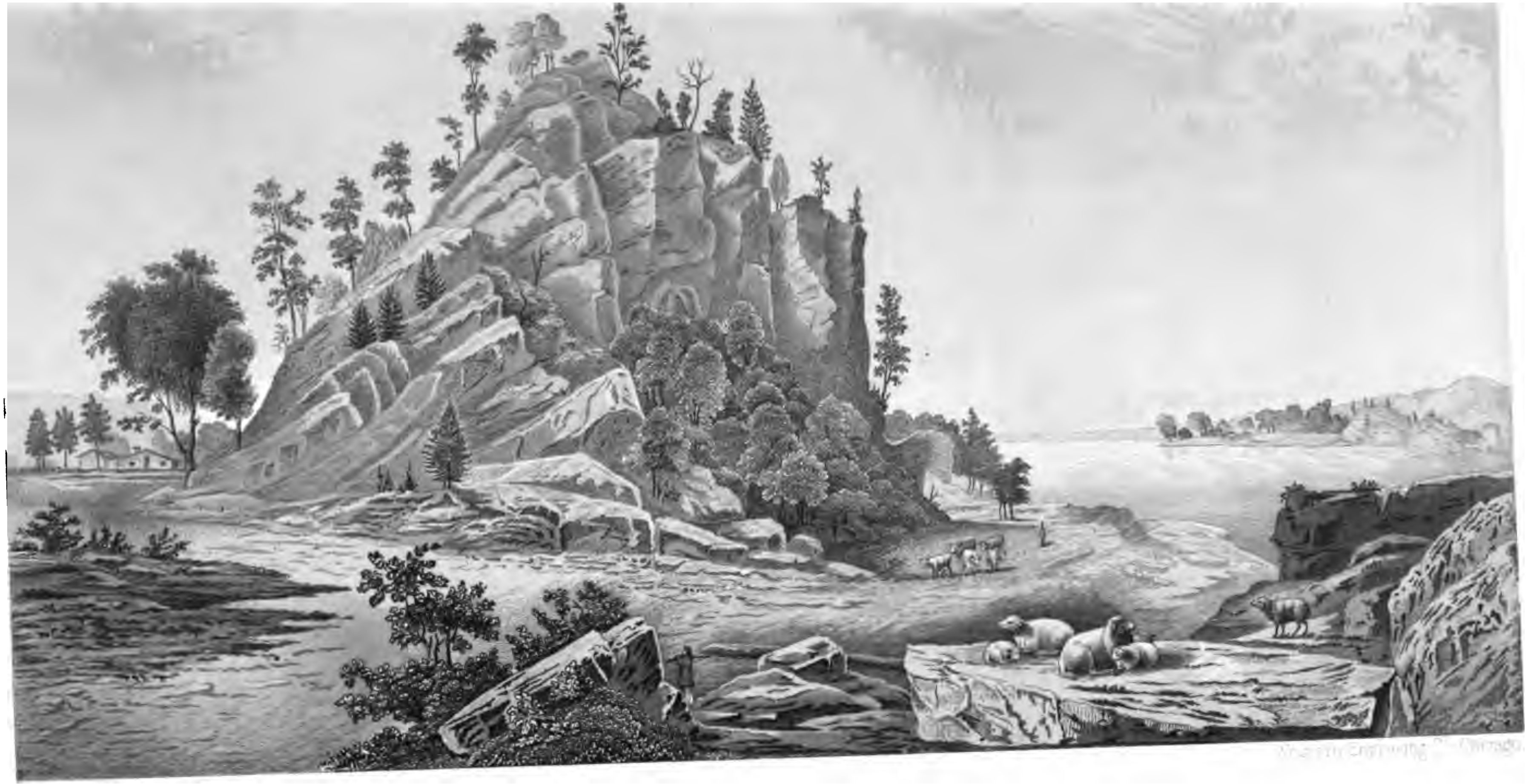
The main chain of bluffs in the southern part of the county is on the eastern side of the Big Muddy, which enters the Mississippi bottom in the northern part of township 9 south, range 3 west, and from this point the river winds along the eastern borders of the bottom, near the bluffs, to the south line of the county, in a direction nearly south, in accordance with the general trend of the bluffs. To the northward of the point where the Big Muddy enters the bottom, the trend of the bluffs is north-westward to the Randolph county line.

## *Geological Formations.*

The geological structure of this county includes a wide range of formations, embracing an aggregate thickness of about two thousand seven hundred feet of strata, and ranging from the top of the lower coal measures down through the Conglomerate, the Lower Carboniferous and Devonian, to the base of the Upper Silurian series, and thus affords a wide and varied field for exploration, such as is afforded by few counties in the State. The Devonian beds at the "Bake Oven" were the first recognized rocks of this age in the State, and the disturbed condition of the strata, and the bold and picturesque scenery on both sides of the river, at this locality, have rendered this one of the most attractive localities for the tourist, as well as the geologist, to be met with in the southern portion of the State.

The *Grand Tower*, which is an isolated cliff of limestone, standing out and forming an island in the river nearly a hundred feet above the low-water level, has long been a conspicuous land-mark for the traveler on the Lower Mississippi.

The following section will illustrate the geological structure of this county, and the order of sequence and thickness of the different groups of rocks found within its limits:



Western Engraving Co. Chicago.

"BACK-BONE" JACKSON CO.

*Perpendicular Section of the Rocks in Jackson county.*

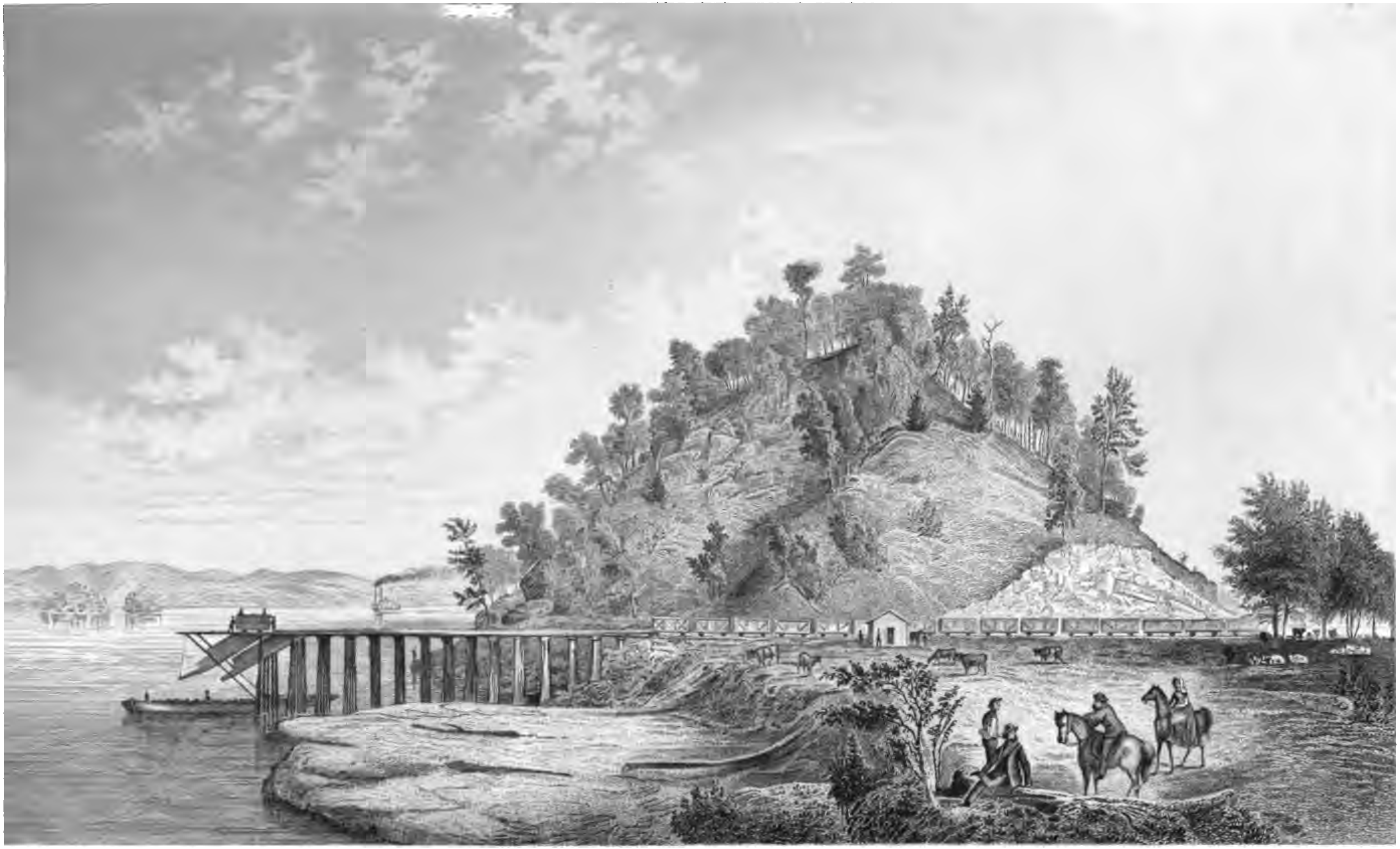
| | Feet. | |
|---|---|---|
| Quaternary. | 200. | **Alluvium, Loess and Drift.** |
| Conglomerate and Coal Measures. | 500 to 600. | **Lower Coal Measures, consisting of sandstones, shales, slates, thin beds of limestone, with three or more seams of coal, ranging from two and a half to four feet in thickness.**<br>**Conglomerate: Quartzose sandstone, often massive, and inclosing pebbles of quartz, passing upward into thin bedded, soft, micaceous sandstones; the whole series ranging from five to six hundred feet in thickness, including the Coal Measures.** |
| Lower Carboniferous Limestones. | 800. | **Chester Group: Gray and brown argillaceous limestones, alternating with sandstone and sandy or argillaceous shales.** |
| | 250. | **St. Louis Group: Light gray limestones.** |
| | 150. | **Keokuk Group: Cherty gray limestone.** |
| | 100? | **Burlington Limestone: Brown crinoidal limestone.** |
| | ? | **Kinderhook Group? Not exposed.** |
| Devonian. | ? | **Black Slate? Not exposed.** |
| | 60 to 100. | **Hamilton Group: Dark colored, fœtid limestone, with some intercalations of calcareous shales.** |
| | 60. | **Onondaga Limestone: Light gray silicious limestone, sandstone, and striped silicious shales.** |
| | 250. | **Oriskany Group: Clear creek limestone, consisting of alternations of limestone and chert, passing locally into a complete chert rock.** |
| Upper Silurian. | | **Band of brown shale.** |
| | 200. | **Lower Helderberg Limestones: Buff and gray magnesian limestones, in thin beds, alternating with chert.** |

The lower divisions of the foregoing section outcrop only over a very limited area in the south-western corner of the county, where they are elevated above the surface level, by the uplift which crosses the river about three miles above the south line of the county, with a trend from north-west to south-east. We will now describe the general character, thickness and extent of outcrop of the formations that are developed in this county, beginning with the lowest:

*Lower Helderberg Limestone.*—This formation outcrops only in the river bluff near the south line of the county, commencing near "Bald Rock" and extending south from there into Union county. It has been fully described in the foregoing chapter on that county, and the description need not be repeated here.

*Oriskany Group.*—This group consists of a series of cherty, silicious limestones, and light gray, massive, crystalline limestone, the whole attaining an aggregate thickness of at least two hundred and fifty feet. It forms the prominent hill known as "Bald Rock," on the Big Muddy, and from that point it forms the upper part of the bluffs to the south line of the county. "Bald Rock" is a bold, rocky precipice, rising abruptly from the water level to a hight of at least two hundred feet, on the eastern bank of the Big Muddy, the waters of which wash its base. The upper part of the exposure, for a thickness of a hundred feet or more, consists of heavy beds of limestone, partly cherty and silicious, while other portions are composed of white, or light gray and drab crystalline limestone, quite hard, and apparently susceptible of receiving a high polish, and adapted to the ordinary uses of the marble worker. It is only a limited thickness of strata, however, that are of this character, while the most of the layers are too hard and silicious, not sufficiently uniform in texture, and rather cherty to work well, except for rough walls. The lower part of the exposure here, consists of a loose, porous chert rock, similar in all respects to that so fully described as belonging to this horizon in Union county. At the lower end of the "Backbone" these beds are also exposed, and consist, in part, of massive crystalline limestone, variously colored, and streaked with pink, yellowish and blue, and, when polished, they form a beautiful marble. These massive beds attain a considerable thickness, but from the disturbed condition of the strata, could not be accurately measured. They are here underlaid, also, by a porous, cherty rock, a hundred feet or more in thickness. The calcareous beds abound in fossils, among which the remains of *Crinoidea* were abundant, consisting mainly of columns and plates. These beds are the equivalent of the Clear creek limestone, of Union county, and present very similar characters to the outcrops already described in that county, except that the massive calcareous beds form a more conspicuous feature at the "Bald Rock" than at any point observed farther south, though they are no doubt represented in Union county by the white and bluish gray limestones on Huggins' creek, already described in the foregoing chapter.

*Onandaga Group.*—The arenaceous beds which succeed these cherty limestones in the ascending order occur at the "Bake Oven" forming the base of



LOWER END OF THE BACK BONE, JACKSON CO.

VIEW LOOKING NORTH

the bluff, and at the bottom they constitute a true quartzose sandstone, while above they consist of alternate layers of sandstone and silicious limestone, attaining altogether a thickness of thirty-five to forty feet. The fossils from this bed are crushed and in a poor condition for determination, so that it is difficult to say positively whether they are most nearly allied to the beds below or above. From the fact that it becomes more and more calcareous towards the top, and finally passes into the light gray limestone of the Onandaga period above, it would seem probable that these arenaceous beds also might with equal propriety be considered as belongiag to this higher division of the Devonian series. This sandstone is succeeded by a massive light gray semi-crystalline limestone which forms the middle portion of the perpendicular cliff at the "Bake Oven," and attains a maximum thickness of about twenty-five feet. Its only outcrops are in the river bluffs at the "Back-bone" and the "Bake Oven," and possibly at "Bald Rock," on the east side of the Big Muddy river. The fossils characteristic of this limestone have already been enumerated in the foregoing chapter, pages 39 and 40.

*Hamilton Group.*—The upper beds exposed both at the "Backbone" and "Bake Oven" consist of dark gray, silicious, fœtid limestones with intercalations of calcareous shales, attaining altogether a thickness of a hundred feet or more. These limestones are well exposed at the "Bake Oven," where they form the upper part of the perpendicular escarpment, and also at the upper end of the "Back-bone" where they form the northern extremity of the ridge. On top of the ridge, about one-third of the distance from the upper to the lower end, there is a bed of calcareo-argillaceous shale, mostly buff-colored, and from ten to fifteen feet in thickness. It is probably about the middle of the series, though the exposures were too incomplete to give us an entire section. The lower beds contain comparatively few fossils here, but have afforded several species, among which are a large *Gomphoceras*, of which several specimens were obtained, *Nautilus (Discites) ornatus*, a large *Strophomena*, a *Lucina*, like *L. proavia* and *Chonetes Littoni*. The upper beds contain the following species: *Chonetes carinata*, *C. Martini*, *C. pusilla*, *Tropidoleptus carinatus*, *Atrypa reticularis*, *Strophomena rhomboidalis*, *S. demissa*, *S. fragilis*, *Orthis Iowensis*, *Spirifer fornacula*, *S. formosa*, *Phacops bufo*, and several undetermined species of *Zaphrentis*, with a few fragments of fishes. These limestones have only been seen at the two localities above cited, and at the lower extremity of Walker's Hill, immediately east of the lower end of the "Backbone" ridge, where only a few feet in thickness of these Hamilton limestones are exposed; and on the east side of the Big Muddy, where we might naturally expect to find them overlying the Lower Devonian strata that are so well developed there, they have not been seen, and appear to have been crowded under the superincumbent limestones of the Lower Carboniferous series, the result probably of the disturbance which has elevated the Devonian strata above the surface at this point.

All the limestones above described are limited in their outcrop to a very small area, and are strictly confined to the river bluffs in the south-west corner of the county, and although they attain an aggregate thickness of between six and seven hundred feet, their outcrop does not cover an area of more than two miles square. Above the Hamilton limestone we should expect to find the usually succeeding *Black Slate*, but no exposure of it was found in this county, though at the lower end of Walker's Hill, we find a covered slope of considerable thickness immediately above the limestone, that is probably underlaid by the shaley beds of this series, and perhaps in part also by the silicious shales of the Kinderhook group.

The beds forming this hill dip rapidly to the northward, and between its northern and southern extremities we find the local outcrops of partially exposed beds that appear to represent the whole Lower Carboniferous series, from the Kinderhook group to the top of the St. Louis limestones inclusive.

*Burlington Limestone.*—The outcrop of this formation already cited, is the only one met with in this county, and the most southerly one known in the State. It occurs on the western slope of Walker's Hill, nearly opposite to the lower and of the "Back-bone" ridge, and exhibits only a part of the formation, consisting, so far as seen, of brown and brownish-gray crinoidal limestone in tolerably regular beds, and in part in tumbling masses on the top of the hill. This exposure was not sufficient to afford an accurate measurement, but the formation appeared to be at least fifty feet in thickness, and is possibly considerably more.

*Keokuk and St. Louis Groups.*—The upper end of Walker's Hill is composed of gray limestones, which are but partially exposed in the outcropping strata, or in tumbling masses on the hill side, but which are easily identified as belonging to the groups above named. The hill is about half a mile in length from north to south, and these limestones occupy the upper or northern end of the hill, with a strong dip to the northward, which carries the whole series underground in a distance of about a quarter of a mile. The whole thickness of the Lower Carboniferous limestones outcropping in this hill is probably not less than four or five hundred feet. North of this hill there is a valley of about a half a mile in width, separating it from Fountain Bluff, the lower end of which, as we have already stated, is formed by the upper beds of the Chester series, while the lower beds of that series were worn away by the denuding forces which excavated the valley. None of the limestones above mentioned, except those of the Chester group, have been identified anywhere in the county, except in the river bluffs near the southern extremity of the county, and at Walker's Hill, which is but a half mile to the eastward of the river bluff. Their outcrop in this county is entirely due to the axis of elevation which crosses the river at this point, with a general trend from north-west to south-east, and intersects only the south-west corner of this county, and on the eastern side of the Big Muddy, all the Lower Carboniferous series below the

Chester Group, as well as the upper part of the Devonian series were apparently crowded under the Chester beds, which here immediately succeed the Lower Devonian strata, though they are not found resting upon them. Their outcrop covers an area in this county of scarcely more than two square miles.

*Chester Group.*—This group, though not fully exposed in Jackson county, nevertheless occupies a much greater area than the subordinate groups, and outcrops over a surface of about twenty-five miles square, but is confined to the river bluffs and the valleys of some of the adjacent streams. Commencing on Digognie creek, at the south-west corner of the county, its upper divisions form the river bluffs, capped, in part, by the Conglomerate, nearly down to where Kincaid creek enters the Mississippi bottom, and on the last named creek, commencing on the north-west quarter of section 28, township 8 south, range 3 west, they extend thence along the valley of the creek, through township 8 south, range 4 west, and on to some of its head branches in the adjoining township on the west. They also form the valley of Digognie creek, as far as it runs in this county, and the outcrops on Reed's creek and Cochran's creek, nearly to their heads. Through township 9 south, range 3 west, the trend of the bluffs is so far to the eastward that these limestones are not seen, and the bluffs are formed by the Conglomerate sandstone; but on section 14, township 10 south, range 3 west, they again come to the surface and continue along the bluffs to within about two miles of the county line, from whence they trend off to the south-eastward into Union county. They also appear on two or three of the southern branches of Cedar creek, and for a short distance, also, on the main creek on section 13, township 10 south, range 3 west. At *Fountain Bluff*, on the Mississippi, they form the base of the hill, which is capped with Conglomerate at the lower extremity, while the latter formation forms the entire elevation at the northern end of the hill. The following section, made by Mr. **Engelmann**, at the county line near the north-west corner of the county, probably exhibits as great a thickness of strata as can be found at any locality in the county:

*Section of the River Bluffs near Digognie Creek.*

| | | |
|---|---|---|
| No. 2. | Fine grained quartzose sandstone, partly exposed | 35 feet. |
| No. 3. | Dark bluish gray limestone, silicious and cherty, probably the second limestone in the series from the top | 40 " |
| No. 4. | Slope, partly underlaid with sandy shales | 20 " |
| | Massive quartzose sandstone | 40 " |
| No. 5. | Limestone, upper part of the bed, only, exposed | 20 " |

The lower limestone in the above section is probably the equivalent of the upper bed at Chester, and its position is consequently near the middle of the series. It is the lowest division exposed in the north-western portion of the county, and perhaps the lowest that appears above the surface in the county.

The following is a section of the river bluffs at Mr. **Wright**'s place, on the west part of section 35, township 8 south, range 4 west, and gives a good idea of the character and thickness of the upper division of the group in this county:

| | | |
|---|---|---|
| | Quartzose and ferruginous sandstone, (Conglomerate) | 5 feet. |
| No. 1. | Limestone, upper part only partly exposed | 40 " |
| No. 2. | Slope, hidden, probably underlaid with sandstone | 20 " |
| | White quartzose sandstone | 46 " |
| | Slope, underlaid with shales, interstratified with limestones | 41 " |
| No. 3. | Dark gray silicious limestone | 8 " |
| | Slope, with masses of silicious limestone | 38 " |
| | Compact brown silicious limestone, perhaps not in place | 3 " |
| | Slope, to high water mark | 18 " |

This section appears to include the three upper divisions of the Chester series, with an aggregate thickness of a little more than two hundred feet. A mile and a half below this point, on the north-east quarter of section 1, township 9, range 2, a seam of carbonaceous shale, with streaks of coal, may be seen in the shales of the upper division of the Chester series. This carbonaceous shale is here about eight inches thick, and is intercallated in argillaceous shales, as seen in the following section:

| | | |
|---|---|---|
| | Conglomerate sandstone, capping the bluff | 30 to 40 feet. |
| No. 1. | Silicious limestone, partly exposed | 28 " |
| No. 2. | Sandstone and sandy shales | 21 " |
| | Argillo-arenaceous shales, passing into argillaceous shale | 22 " |
| | Carbonaceous shale, with streaks of coal | ⅔ " |
| | Argillaceous shale | 6 " |
| | Massive sandstone | 58 " |
| | Slope, hidden to river level | 55 " |

This is undoubtedly the representative of the small seam of coal that has been observed in these limestones in Union, Johnson and Pope counties, and is nowhere of any practical value, but only interesting from the fact that it is the first evidence presented in the development of the Lower Carboniferous series, of the existence of true coal-bearing conditions. This thin seam of coaly matter occurs at several points, both in this county and Randolph, and has given rise to reports of the existence of workable beds of coal in this group of rocks, which are without any true foundation.

The upper sandstone of the Chester series is fully one hundred feet in thickness, and is in part massive and partly thin-bedded and shaley, and frequently presents lines of false stratification, or apparent lines of bedding inclined at a considerable angle to the true stratification of the rock. The black shale and coal mentioned above occurs in the same relative position at Dr. Hodges', on the north-east quarter of section 11, town 8, range 4, and also a mile further south in the north-west quarter of section 14. The upper limestone, or No. 1 of the series, numbering them from the top downwards, outcrops at several points near the summit of the ridge, at the head of Digognie and Reed's creeks. It is also exposed at Mr. Gordon's, on the breaks of Reed's creek, near the county line, and is here highly silicious and interstratified with cherty arenaceous strata, and is directly overlaid by the Conglomerate.

Kincaid creek heads in the Conglomerate, not far from the head of Reed's creek, but on the eastern part of section 12, town 8 south, range 5 west, the creek valley intersects the upper limestone which has here been burned for lime, and it continues thence down the creek for several miles through sections 5, 4 and 9, and into section 10. There are some small caves in the limestone here, and numerous sink holes, and it is intersected with veins of calcareous spar. Lower down on the creek on the south-east quarter of section 3, blue argillaceous shales outcrop above the limestone, in which are embedded numerous concretions of carbonate of iron. This shale appears to be at the base of the Conglomerate. On section 24, township 8 south, range 3 west, a bed of highly ferruginous sandstone occurs which changes locally into a brown hydrous peroxyd of iron, somewhat mixed with flint and sand, and about a foot in thickness. This appeared to occupy about the same position in the strata as the iron carbonates above mentioned, that is, near the base of the Conglomerate.

*Fountain Bluff* or "Big Hill," as it is sometimes called, is formed by these upper divisions of the Chester series and the Conglomerate. The former beds occupy the entire elevation at the lower end of the hill, but the strong northerly dip soon carries them below the river level, and the upper or northern portion is composed entirely of the Conglomerate. At the base of the hill on the south and south-eastern side, silicious limestones, interspersed with shales are seen, and these are overlaid by a massive sandstone, forming a cliff eighty feet in hight. Still higher up are partial outcrops of shaley limestone, with *Archimedes* and other characteristic fossils of this series, and still higher the sandstones of the Conglomerate. From these observations it would seem that we have at the lower extremity of this hill the three upper divisions of the Chester group, embracing two limestones and a sandstone. At the upper end of the hill the Conglomerate forms the entire exposure, and rises in towering cliffs 120 feet at least above the adjacent river bottoms.

Below the mouth of Cedar creek, at Herald's old mill, a few feet in thickness of the upper limestone of this series was seen overlaid by heavy beds of Conglomerate, and from this point it gradually rises in descending the bluffs, in consequence of their more western trend. Approaching Bald Rock the dip increases, and near the mouth of Rattle-snake creek, the beds dip north-east at an angle of thirty degrees. This is the most southerly outcrop of these limestones in the river bluffs, and from this point they trend off to the south-east into Union county.

The most easterly outcrop of these limestones in Jackson county is on the upper course of Cedar creek, near Williams' mill, on the south-west quarter of section 35, township 10 south, range 2 west. At this point the lowest strata exposed, consist of a dark gray, uncrystalline, hard and brittle limestone, which are succeeded by brownish gray, argillaceous, and sub-crystalline limestones, the whole forming a bed forty feet or more in thickness. The fossils observed here were: *Productus elegans*, *P. pileiformis*, *Athyris ambigua*, an Orthoceratite, etc. The mill is driven by a spring which issues from the limestones near the top of the exposure, and it appears to have a subterranean connection with the western branch of the creek, as the flow of water from the spring is apparently governed by the amount of water in this branch.

It is probable that all the outcrops of Chester limestones observed in this county belong to the upper divisions of the series, and that the lower members are now entirely hidden in the vallies that intervene between these outcrops and the older formations. From their general similarity in lithological characters and the wide range of the characteristic fossils of the group through the whole series, it is difficult to decide to what part of the series an outcrop of limestone belongs, unless the associated beds are also well exposed, so that its position can be determined by the sequence of the strata.

*Conglomerate.*—The term Conglomerate Sandstone or Millstone-grit, is used to designate a thick bed of sandstone that lies at the base of the Coal Measures, and as it also contains local developments of coal sufficiently important to be worked profitably at some points, it may very properly be considered as the base of the true coal-bearing rocks. Through all the counties that border the Illinois coal field south of Randolph, this formation is largely developed, attaining a thickness of two, or sometimes, perhaps, as much as three hundred feet. It consists of quartzose sandstones, mostly nearly white, but sometimes colored by ferruginous matter, and frequently contains rounded pebbles of quartz rock, from the size of a pea to those three or four inches in diameter. When ferruginous it weathers very unevenly, and leaves a hard brown crust upon its surface, formed of sand, cemented by the brown oxyd of iron. Where the quartz pebbles are abundant, the finer materials disintegrate from around them on the exposed surface, and leave them projecting from the perpendicular walls of sandstone, like partly embedded cannon balls. Locally it passes into shales or thin bedded limestones, and it contains thin beds of argillaceous shales. The sandstones are sometimes soft, and decompose readily on exposure to the atmosphere, and again are more compact and harden slightly on exposure, and such outcrops form towering cliffs and bold escarpments in agreeable contrast to the usual monotony of the more level landscapes.

The *Abneyville rock* is a prominent cliff of this sandstone, about a mile in length, situated on the eastern side of the Big Muddy river, which washes its base. It is situated in sections 23 and 26, township 9 south, range 3 west, and is only about thirty feet in hight above the river level. *Swallow rock* is another prominent bluff of the Conglomerate on the Big Muddy, beginning near the center of section 35, and extending for some distance to the southward. At its northern extremity it forms an overhanging cliff of sandstone sixty feet high, increasing in elevation to the southward, until on section 2, township 10 south, range 3 west, it attains a perpendicular hight of more than two hundred feet above the river. *Figure House rock* is a cliff of sandstone on Cedar creek, about half a mile above its mouth, remarkable only for the rude figures carved on it by the former inhabitants of the country. These consist for the most part of rude figures of the human form, with others resembling bird tracks, arrow heads, etc.

At the top of the Conglomerate there is usually a seam of coal that averages about eighteen inches in thickness, and forms an easily recognized horizon in tracing the sequence of strata, scarcely to be distinguished otherwise by any change in their lithological characters. This formation caps the river bluff throughout the county, except at a few localities in the extreme south-western part already mentioned, where they are composed of Silurian and Devonian strata, and through the more northern part of township 10 south, range 3 west, and nearly the whole of 9 south, range 3 west, this sandstone forms the entire elevation of the bluffs, and also covers a belt of country immediately to the eastward of them, averaging from three to six miles in width.

In the extreme southern portion of the county, it outcrops from Cave creek to the county line of Williamson county, and forms the valley of both branches of Drury's creek, to the middle of township 10 south, range 1 west, and on Cedar creek it occupies the valley of that stream through the northern and eastern portions of township 10 south, range 2 west. It extends up the valley of the Big Muddy, above the mouth of Lewis' creek, and outcrops on the lower course of Kinkaid creek, from the north-west quarter of section 28, township 8 south, range 3 west, to the river bluffs. It caps the highlands between the upper course of Kinkaid creek and the river bluffs, and also forms the valley of North Fork and Little Kinkaid. It forms the valley of the north fork of Mill creek, at the county line of Randolph county, underlying a belt of country about three miles in width, trending north-eastward into that county. The outcrops of coal at the top of this formation will be mentioned under the head of Coal Measures.

*Lower Coal Measures.*—The Lower Coal Measures, as they are developed in this county, cover an area about equal to one-half of the county, and if a line is drawn diagonally from the south-east to the north-west corner, it would define very nearly the western boundary of the coal field in this county. These lower measures include a thickness of about two hundred and fifty, or possibly, three hundred feet of strata, consisting mainly of sandstones and shales, with some thin beds of limestone, and three or four seams of coal, probably including all the beds, from the horizon of the DuQuoin coal to the base of the measures. The lowest persistent seam in this series is the one outcropping just at the top of the Conglomerate. It is usually from sixteen to twenty-four inches in thickness, and affords a coal of fair quality, but is too thin to be worked with profit, except by stripping at its outcrop. The next coal in the series, of a workable thickness, are the Murphysboro coals, which are well exposed on the Big Muddy, near the town, where the rocks show the following section, from the top downwards:

| | | | |
|---|---|---|---|
| Micaceous sandstone, with partings of shale | 20 | feet. | |
| Coal, upper seam | 3 | " | |
| Dark blue clay shale | 12 | " | |
| Brown areno-argillaceous shale, with iron nodules | 15 | " | |
| Coal | 3 | " | |
| Clay parting, from two to eight inches | 0 | " | 8 inches. |
| Coal | 2 | " | |
| Shale, with nodules of iron ore | 20 | " | |
| Sandstone, extending below the river level | ? | " | |

Extensive mining operations have been carried on here for many years, and formerly the coal from these mines was floated down the Big Muddy on barges, and across the Mississippi to the highlands on the west side, in Missouri, where a coal depot was established when the mines were first opened. Recently these mines have passed into the hands of some eastern capitalists, a joint stock company has been formed under the title of the "Mount Carbon Coal and Railroad Company," and a railroad has been constructed from the mines to the Mississippi river, at the lower extremity of the "Back-bone," where a coal depot has been established.

The lower seam, or rather, the two lower seams, though they are worked as one, is mainly wrought here, and the lower part of it, below the clay parting, affords a coal of excellent quality, and sufficiently free from the sulphuret of iron to be used in a raw state for smelting iron, a quality which greatly enhances its value from its proximity to the St. Louis market, and the immense iron deposits of Missouri. The upper part of the seam also affords a good quality of coal, but contains more sulphuret of iron than that below. The seam of clay shale is variable in thickness, ranging, in the vicinity of the shaft, from two to six inches, and appears to increase in thickness towards the south, so that in a distance of less than a mile in that direction, it is ten feet thick, and the lower division of the seam has thinned out altogether. The thickness of the top coal varies from thirty to forty-two inches, and the bottom from twenty-two to thirty-two inches.

Very little has been done here towards mining the upper seam in the foregoing section, and its maximum thickness in this vicinity may be set down at about three feet, and from this it ranges down to a mere streak of bituminous matter. At the Mount Carbon mines, where it had been opened and drifted on for some distance, it ranges from twenty-four to thirty inches in thickness, with a sandstone roof. The quality of the coal does not appear to be equal to that from either division of the lower seam. On the north side of the Big Muddy, around Murphysboro, these coals have not yet been found, and it seems probable that they were cut away in the erosion of the river valley, which was subsequently refilled with Quaternary deposits, and they will probably be found wherever borings are made beyond the northern limits of this valley, at a depth of less than one hundred feet from the surface.

It is possible that the foregoing section represents the three lower coals, and that the lowest one with the clay parting is really two distinct seams, which are here only separated by a thin parting of shale, but it seems more probable that the seam usually developed at the top of the Conglomerate really holds a lower position, and is not represented here. These seams outcrop also about a mile south-east of Carbondale, holding about the same relative position, and the section here is very nearly an exact repetition of that at Murphysboro, except that the lower coal seam is four feet thick and has no clay parting. Seven miles south of this point, near Makanda, a thin seam of coal is found about eighteen inches thick, which must underlie these at Carbondale. These coals appear on Pond creek and Camp creek, and also on both branches of Rattle-snake creek, but presenting at their various outcrops considerable diversity in thickness, and in the character of the enclosing strata. On the north-west quarter of section 15, township 7 south, range 3 west, coal occurs, associated with sandstones, as shown in the following section:

| | |
|---|---|
| Slope of the hill covered with loose masses of sandstone and some of the lower strata in place, not measured | ? |
| Carbonaceous Shale with Coal in fragments | 1 foot. |
| Soft Sandstone with particles of Coal | 8 feet. |
| Coal | 2 feet 6 inches. |
| Sandstone extending below the creek level | ? |

At another exposure near by the carbonaceous shale above the coal was wanting, and the coal was directly enclosed between the sandstones. Near the center of section 22, in what is known as the "Killian Settlement," coal is found from five to six feet in thickness. It contains some sulphuret of iron, but appears to be of fair quality. It is said to rest on sandstone, and the roof, where it has not been removed by surface agencies, appears to be also sandstone which outcrops near by, just above the level of the coal. The same coal retaining about the same thickness was found by Mr. Killian in digging a well near the south-east corner of section 16. It was overlaid here by Drift clay, and rested directly on sandstone. The character of the strata accompanying this coal would seem to ally it to the upper seam at Murphysboro, but no attempt has been made in this neighborhood, so far as we know, to determine whether there was a workable coal below this or not.

The shales associated with the lower coals of the foregoing section abound in fossil plants, and where the shales are argillaceous the plants may be obtained in a very fine state of preservation. The shales above the lower coal also contains numerous nodules of impure iron ore, exactly like those from Mazon creek, in Grundy county, and contain many of the same species of plants, and hence we infer that these seams belong to about the same horizon, and are probably also the equivalents of the Colchester coal in McDonough county, the roof of which contains similar nodules enclosing plants.

One mile and a half south-east of Carbondale, on Dr. WM. RICHART'S place, coal has been opened by a shaft, while another and higher seam outcrops in the hill above, affording the following section:

| | | |
|---|---|---|
| Micaceous Sandstone and Sandy Shale | 15 | feet. |
| Coal | 3 | " |
| Fire Clay and Clay Shale partly hidden | 35 | " |
| Coal | 4 | " |
| Fire Clay | 5 | " |
| Sandstone | 15 to 20 | " |

These coals and the beds associated with them appear to be the stratigraphical equivalents of the Murphysboro coals, and most probably represent the upper seam and the upper division of the lower coals at that point. The blue shale above the coal contains traces of coal plants and *Lingula umbonata*. A half mile further to the south-east, the lower seam in the above section is opened on Dr. STORER'S land by drifting into the south-eastern slope of the hill at its line of outcrop. It presents no marked variation in its appearance here, from what was observed at Dr. RICHART'S. The base of the upper sandstone in the foregoing section is said to be sixty-nine feet above the railroad grade, at the depot in Carbondale. To the northward of the range of low hills in which these coals outcrep, there is a broad valley about five miles in width, extending to Crab Orchard creek, and in the bluffs of this creek a seam of coal outcrops, which is probably the upper coal in the foregoing section. In the intervening valley this upper seam, and probably the lower one also has been entirely cut away by the erosion of the strata, as no coal has been met with in sinking wells in this valley, except at one point where a coal representing the lower seam probably was reached.

About four miles south-east of Carbondale, on the north-east quarter of section 36, township 9 south, range 1 west, just on the county line of Williamson county, two coal seams outcrop, probably the same as those in the foregoing section, but occurring under different conditions. The following is the section here:

| | | | | |
|---|---|---|---|---|
| Massive sandstone, not measured | | | | |
| Compact, silicious, gray limestone | | 3 | feet. | |
| Gray shale, with nodules of iron ore | | 4 | " | |
| Coal, varying in thickness from | 4 to | 4 | " | 4 inches. |
| Slope, with partial outcrops of shale | | 31 | " | |
| Coal, variable in thickness from | 1 to | 2 | " | 6 inches. |
| Blue shale, underlaid by sandstene | | ? | " | |

While we have in the sections given above as many as three distinct coal seams, developed around the extreme borders of the coal field in this county, yet towards the north-west they decrease in number, so that there is probably but one in the western part of the county that is thick enough to be of any practical value.

About a mile north-west of DeSoto, at Mr. FARNER'S, on a high point on the north-west quarter of section 17, township 8 south, range 1 west, the following strata were passed through in a well:

| | |
|---|---|
| Soil and Drift clay | 20 feet. |
| Silicious limestone | 7 " |
| Silicious shales, hard | 20 " |
| Hard black slate | 8 " |
| Coal | 4 " |
| Shale | 8 " |

The limestones in this vicinity are hard, close textured, silicious, and rather light colored, gray or brown, and contain the following species of fossils: *Productus longispinus*, *Spirifer cameratus*, *S. Kentuckensis*, *S. lineatus*, *Athyris subtileta*, *A. Royissii*, *Retzia punctulifera*, *Chonetes mesoloba*, etc. This group of fossils would seem to indicate a close proximity to the DuQuoin coal, No. 5, of the general section of the Coal Measures in the valley of the Illinois river, (see Chapter I, p 5), and it may be that this is an out-lier of that seam. At DeSoto a shaft was sunk to the depth of eighty-two feet, and a boring was carried down 105 feet further, without finding any coal of any practical importance. This shaft was probably commenced below the horizon of the seam in FARNER's well, which is located on ground considerably higher than the level of the town.

On the elevated land between the Little Muddy and Beaucoup, limestones similar to those already mentioned at Farner's, are found at various points, as on Little Muddy, two miles north of DeSoto, and at Elk Prairie, near the north-east corner of section 19, township 7 south, range 1 west, where the bed appears to be as much as eight feet in thickness. On the south-west quarter of the same section the limestone was struck at a depth of twenty feet, and below this a sandstone with a thin seam of coal. On Span's creek, just over the line in Perry county, a coal seam has been opened which will be described in the report on that county, and farther up the creek, on section 4, township 7 south, range 2 west, fragments of limestone are found in the creek, and at Mr. Porter's in a well dug on section 3, large masses of limestone was found at a depth of twenty-five feet. The limestone was separated into large masses with crevices between, through which the augur passed unimpeded. This limestone closely resembles that at Farner's, near DeSoto, and on the Beaucoup, and contains the same fossils, and probably belongs to the same bed. In another well a few rods distant, no limestone was found, but coal was struck at a depth of twenty-nine feet. It is probable this well was sunk through a wide fissure in the limestone, that had subsequently been filled with clay. The underlying sandstone on Six-Mile creek, below Mr. Wilson's, contains a streak of coal two inches thick, which seems to be an exact repetition of the strata at Elk Prairie. It is probable that the limestone mentioned above with its associated coal and sandstone, forms the highest portion of the Coal Measures developed in this county, and the dip which along the Illinois Central Railroad, is to the northward, is changed in the north-western part of the county to a more easterly direction, and becomes slight and undulating. As no reliable boring has been made in the northern part of the county, where the whole series would probably be found, it is not possible to give a connected section of the strata belonging to the Coal Measures in this county, but the following tabular statement, prepared by Mr. ENGELMANN, gives the locality, thickness and depth below the surface of all the coals found in the county:

*Localities of Coal in Jackson County.*

| Number. | Name. | Township | Range... | Section... | Quarter | Thickness. *Inches.* | Depth of Coal. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 1 | O'Donnel.............. | 10 | 1 | 32 | S. of S.W... | 24 | Outcrop.... | Nos. 1 to 9 are the most southerly outcrops of the Coal at the top of the Millstone-grit. |
| 2 | Ben Wiley............ | 10 | 1 | 28 | S. W....... | 30 (?) | " .... | |
| 3 | Stonefort............ | 10 | 1 | 27 | N. E....... | 12 | " .... | |
| 4 | On Clay-lick creek.... | 10 | 1 | 30 | S. line...... | 10 or 12 | " .... | |
| 5 | Near Drury's creek..... | 10 | 1 | 17 | S. E. (?).... | 3 or 4 | " .... | |
| 6 | Judge W. Hagler...... | 10 | 2 | 24 | N. half..... | 2 | " .... | Near Cedar creek. |
| 7 | Frank Robinson...... | 10 | 2 | 10 | S. W....... | 4 | " .... | " " " |
| 8 | Th. Etherton.......... | 10 | 2 | 8 | S. E. N. W. | 8 | " .... | On Sugar creek. |
| 9 | Conner................ | 9 | 2 | 32 | S. E........ | 8 (?) | " .... | " " " |
| 10 | Sam Etherton......... | 9 | 2 | 32 | W. side.... | 18 or 22 | " .... | Head of Bear creek. |
| 11 | Osburn................ | 9 | 2 | 30 | S. E. N. W. | 18 | " .... | Head of Shoal creek. |
| 12 | Hooker................ | 9 | 2 | 20 | S. W....... | 18 | " .... | On Lewis' creek. |
| 13 | Town creek............ | 9 | 3 | 13 | S. E........ | 18 | " .... | Nos. 10 to 27 are the most westerly outcrops of Coal at and near the top of the Millstone-grit. |
| 14 | ...................... | 9 | 2 | 18 | N. E........ | 16 | " .... | |
| 15 | Hanson.............. | 9 | 2 | 17 | N. W....... | 16 | " .... | |
| 16 | Indian creek.......... | 8 | 3 | 36 | S. E........ | 20 | " .... | |
| 17 | Breaks of Kinkaid.... | 8 | 3 | 34 | N. line..... | 6 or 8 | " .... | |
| 18 | Jungman.............. | 8 | 3 | 26 | W. line.. .. | 16 | " .... | |
| 19 | Hipel................. | 8 | 3 | 23 | N. W....... | 30 (?) | 20 feet..... | |
| 20 | W. W. Worthen... ... | 8 | 3 | 8 | W. line.... | 20 | Outcrop.... | Breaks of Kinkaid. |
| 21 | Sterling Smith........ | 7 | 3 | 32 | W. half.... | 3 to 5 | " .... | Breaks of Rattlesnake creek. |
| 22 | Jim Smith............ | 7 | 4 | 36 | S. W....... | 36 | " .... | Breaks of Kinkaid. |
| 23 | Downen............... | 7 | 4 | 10 | S. W....... | 48 to 72 | " .... | Head of Brushy Fork. |
| 24 | Jesse Ward........... | 7 | 4 | 20 | E. half..... | ? | 26 feet..... | |
| 25 | W. Bradley........... | 7 | 4 | 7 | N. E....... | 26 (?) | Outcrop.... | |
| 26 | Underwood........... | 7 | 4 | 10 | N. W....... | 24 | " .... | |
| 27 | Koke.................. | 7 | 4 | 4 | N. E. N. W. | 0 to 18 | " .... | |
| 28 | Frank Crane.......... | 7 | 3 | 11 | N. W.... . | ? | " .... | Near Columbo. |
| 29 | Don Morrison's....... | 7 | 3 | 15 | N. W....... | 30 | " .... | On Little Rattlesnake creek. |
| 30 | Kilian................. | 7 | 3 | 16 | S. E........ | 60 to 72 | 38 feet... . | " " " " |
| 31 | Kilian................. | 7 | 3 | 22 | center...... | 60 to 72 | Outcrop.... | " " " " |
| 32 | Jesse Nicholson...... | 7 | 3 | 23 | S. W....... | ? | 50 feet..... | " " " " |
| 33 | Robert Smith......... | 7 | 3 | 35 | N. W....... | 36 | Outcrop.... | Near Big Rattlesnake creek. |
| 34 | Hughes McMillen... . | 8 | 3 | 12 | S. E. S. W. | 36 | " .... | On Camp creek. |
| 35 | Near Pond Creek. .... | 8 | 2 | 20 | S. W....... | 12 | 40 feet..... | |
| 36 | Upper Vein .......... | 9 | 2 | 9 | W. half.... | 0 to 36 | Outcrop.. | Near Murphysboro. |
| 37 | Center vein top Coal.. | 9 | 2 | 9 | W. half.... | 30 to 43 | " .... | " " |
| 38 | Center vein bot'm Coal | 9 | 2 | 9 | W. half.... | 22 to 32 | " .... | " " |
| 39 | ...................... | 9 | 2 | 10 | W. side.... | 12 to 16 | " .... | " " |
| 40 | Muddy river.... ...... | 8 | 2 | 34 | S. W....... | ? | " .... | In the bed of the river. |
| 41 | Jux.................... | 9 | 2 | 16 | S. E........ | 18 to 30 | " .... | |
| 42 | Jenkins............... | 9 | 2 | 22 | S. E........ | Thin. | 12 feet. .... | On Mud creek. |
| 43 | Edwin Hanson........ | 10 | 1 | 8 | N. E....... | 24 to 42 | Outcrop.... | Breaks of Drury's creek. |
| 44 | Jones.................. | 10 | 1 | 3 | S. line. .... | 24 (?) | " .... | Near Indian creek. |
| 45 | Henry Hanson........ | 9 | 1 | 27 | S. line. ... | ? | 22 feet..... | This bed at an intermediate point is only 18 inches thick. |
| 46 | Brooks................ | 9 | 1 | 27 | N. E. S. W. | 48 | Outcrop.... | |
| 47 | Carbondale........... | 9 | 1 | 27 | S. W. N. W. | 24 to 32 | " .... | |
| 48 | Upper bed.... ....... | 9 | 1 | 36 | N. E....... | 48 to 52 | " .... | Near Sycamore branch. |
| 49 | Upper bed............ | 9 | 1 | 36 | E. line..... | 42 | " .... | " " " |
| 50 | Lower bed............ | 9 | 1 | 36 | E. half..... | 12 to 30 | " .... | " " " |
| 51 | On Crab Orcha d. .... | 9 | 1 | 25 | N. E....... | 36 (?) | " .... | |
| 52 | Fish Trap............ | 9 | 1 | 28 | S. E........ | 20 or more. | " .... | On Big Crab Orchard creek. |
| 53 | Snyder...... ......... | 9 | 1 | 23 | S. E. N. E.. | 16 | " .... | " " " |
| 54 | Old Bridge........... | 9 | 1 | 2 | center...... | 20 to 36 | " .... | " " " |
| 55 | Meyer................ | 9 | 1 | 1 | S. line.. ... | 42 (?) | " .... | Breaks of Crab Orchard creek |
| 56 | Snake Den........... | 8 | 1 | 34 | N. E....... | 24 to 36 | " .... | On Big Crab Orchard creek. |
| 57 | Fish Trap.......... .. | 8 | 1 | 14 | S. W....... | 1 to 6 | " .... | On Little Muddy. |
| 58 | Farner................ | 8 | 1 | 17 | N. W....... | 48 | 50 feet..... | Near DeSoto. |
| 59 | On the Railroad....... | 8 | 1 | 8 | S. E........ | 12 (?) | 40 feet..... | " " |
| 60 | DeSoto............... | 8 | 1 | 20 | N. E....... | ? | 70 feet.. .. | Reported to have been struck by boring. |
| 61 | DeSoto................ | 8 | 1 | 20 | N. E....... | Thin. | (?) | |
| 62 | DeSoto................ | 8 | 1 | 20 | N. E....... | ? | 170 feet.... | |
| 63 | Swartz.............. . | 7 | 1 | 19 | N. E....... | 2 | 15 feet..... | In Elk Prairie. |
| 64 | Porter................ | 7 | 2 | 8 | center...... | ? | 29 feet..... | Near Span's branch. |
| 65 | Taylor................ | 7 | 1 | 5 | N. W.... . | 8 | Outcrop.... | On Six-mile creek. |
| 66 | Daviess............... | 7 | 1 | 7 | N. line..... | Over 12 | 16 feet..... | In Elk Prairie. |

REMARK.—The names indicate the nearest habitation, or the name under which the localities are known, but have no reference to the ownership.

Localities numbered from 1 to 27, inclusive, Mr. **Engelmann** refers to the lowest coal in the series, the seam immediately above the Conglomerate, but we think he is certainly mistaken in referring No. 23 to that horizon, and most likely all the outcrops in the northern part of township 7 south, range 4 west, may be referred to a higher position in the series. The lower coals are less developed in Randolph and St. Clair counties than in the southern part of Jackson, and it is probable that this change is effected, in part, at least, before reaching the Randolph county line. Above this lower seam we have the two seams at Murphysboro and Carbondale, and above these the coals north and north-west of DeSoto, some of which may be the equivalents of the DuQuoin coal, though they are somewhat thinner than the average thickness of that coal farther north.

*Quaternary Deposits.*—The uplands in this county are covered by a deposit of clay and sand, with gravel, and a few boulders of granite, trap, and other metamorphic rocks, showing that it may properly be referred, in part, at least, to what is usually called the Drift period, and this county appears to mark its southern limits, for no well marked deposits of this kind have been observed south of the dividing ridge that crosses the State through the south part of Jackson and the north part of Union counties. These drift clays probably do not average in this county more than about twenty feet in thickness, and are penetrated almost everywhere on the uplands in sinking wells. Below these beds of clay and gravel, a deposit is often met with in this county, which has also been observed at many localities in different portions of the State, consisting of a dark blue or black mud, containing branches of trees, and sometimes trees of large size. This deposit varies in thickness from a few inches to ten feet or more, and has been observed in this county at the following localities: On the north-east corner of town 7 south, range 5 west, near the Randolph county line, where it was found in wells twenty-five to thirty feet below the surface; at the town of Shiloh or Steuben, in Randolph county, it is eight to ten feet thick, under twenty feet of Drift deposits; on the south-west quarter of section 24, twonship 7 south, range 4 west, it was found eight feet thick, thirty-five feet below the surface, and was underlaid by gravel and sand, and at Jesse Ward's, on the south-east quarter of section 20, township 7, range 4, and on section 16, it was found from twelve to fifteen feet thick. It has also been noticed two miles west of Carbondale, where it was struck in several wells, but its thickness was not ascertained. It was from twenty-five to thirty feet below the surface, and above a water-bearing stratum of sand.

The *Loess* formation in this county consists mainly of comminuted silicious silt, usually of a light-brown or buff color, and locally it becomes a yellowish loam with calcareous concretions. At some localities the mass is slightly cemented, so as to form high perpendicular escarpments on the summits of the hills, and presents but slight traces of stratification. It occupies only a narrow belt on the top of the river bluffs from the west line of the county to the vicinity of the Pine hills near the south line. These hills were probably above the level of the water during the deposit of this formation, and hence they are not covered by it. On the east side of Fountain Bluff this formation extends down to the level of the river bottoms, and probably once filled the valley between this and the main chain of bluffs. The soil over the highest portions of the river bluffs appears to be derived, in part, at least, from this formation, and the yellow poplar or tulip tree flourishes best where the soil is underlaid by beds of *Loess.*

## *Economical Geology.*

*Bituminous Coal.*—Although the coal seams outcropping in this county are for the most part rather thin, and are therefore not extensively worked at the present time, and the thickest and most profitable beds outcrop at points remote from railroads, and where the local demand is limited, yet the supply of this indispensable requisite to the industrial interests of the country is abundant, and will be developed in the future as the demand for it increases. There are at least three, and perhaps four seams outcropping within the limits of this county, ranging in thickness from a few inches to six feet. The thickest coal is that outcropping in the northern part of the county, at the head of Brushy Fork, and at Kilian's, on the waters of Rattle-snake creek, and at Farner's near DeSoto, where the coal ranges from four to six feet in thickness. These may be the equivalent of the upper seam at Murphysboro and Carbondale, but more probably belong to another horizon. The seams below this, except at Murphysboro, where two seams appear to run together so as to be worked as one, do not usually exceed three feet in thickness, and are often found too thin to be mined to advantage, except where they outcrop so that they can be worked by stripping.

About one-half of the superficial area of this county is underlaid with coal, embracing all the north-eastern portion, and a line drawn from the south-eastern to the north-western corner of the county, would very nearly define the south-western limits of the coal-field. The lowest seam in the series is that occurring usually at the top of the Conglomerate, and its most southern outcrops are numbered from one to ten in the foregoing tabular statement, and its thickness in this portion of the county ranges from three to thirty inches. Its character is variable; at some localities it affords a coal of excellent quality, and at others it is quite poor, and mixed with slate and sulphuret of iron. It is doubtful if this seam extends into the north-western portion of the county at all.

The next coals in the series are those of Murphysboro and Carbondale, of which a section is given on a preceding page. At the first named point three seams are developed, the two lower ones being so near together that they can be worked as one seam. This is an excellent coal, one of the best known in the State, and has been successfully used in its raw state for smelting iron.

These mines are said to have been opened as early as 1810, and a flat boat load of coal from this point was shipped that year to New Orleans, and in 1822 Gov. JOSEPH DUNCAN loaded several boats here with coal for the same market. More recently these mines were wrought for several years by the Jackson County Coal Company, the coal being loaded onto flat-boats and then towed down the Big Muddy to their depot on the west bank of the Mississippi. This, however, proved to be an uncertain mode of transportation, because during a considerable portion of the year the Muddy river was too low to allow the boats to run at all, and at best they could only run a small part of the season. About two years since the Mount Carbon Coal Company built a railroad from these mines to the Mississippi, making their terminus and depot at the lower end of the Back-bone ridge, thus giving themselves an easy and certain access to the river markets at all seasons of the year. This road, which is only about fifteen miles in length, has been in successful operation for the past year in the transportation of coal, and is now being extended to Carbondale, on the Illinois Central Railroad, which will give an outlet for this coal in that direction also. Nearly all the coal mined at this point has been taken from the lower seams, which are here separated by a parting of clay shale from a few inches to 2 feet in thickness.

The upper division of the seam averages about three feet in thickness, and the lower about two feet. The coal from both divisions is good, though that from the lower seems to be the freest from sulphuret of iron. The coal is hard and bright, and the layers separated by carbonaceous clod or "mineral charcoal." An analysis of this coal by Mr. HENRY PRATTEN, formerly Assistant Geologist and Chemist of the survey, gave the following result:

| | | | |
|---|---|---|---|
| | Specific gravity | 1,2933 | |
| | Loss in coking | 37-7 | |
| | Total weight of coke | 62-3 | 100 |
| ANALYSIS— | Moisture | 6-5 | |
| | Volatile matters | 31-2 | |
| | Carbon in coke | 60-8 | |
| | Ashes | 1-5 | 100 |

The northern limit of this seam has not been determined, and the next outcrops in that direction on Pond and Indian creeks, reveal only a thin seam of coal from six to twelve inches thick, and it is probable that the Big Muddy coal as it appears in the vicinity of Murphysboro, is a local development of limited extent. At Carbondale the lower division of the main Murphysboro seam is not found at all, and the upper division is about four feet thick, while the upper seam, thirty-five feet above the lower, is three feet in thickness. If we are right in our supposition that the lower division of the main Murphysboro coal may be a distinct seam, the two being brought so near together here by the thinning out of the intervening strata that they can be worked as one, then that lower seam may be the eighteen-inch coal outcropping near Makanda, at the top of the Conglomerate, and this supposition is strengthened by the fact that the clay parting which divides the lower seam at Murphysboro increases in a southerly direction so rapidly that a mile distant in that direction the divisions are too widely separated to be worked as a single seam.

The coals outcropping in the northern part of the county, which seem to hold a higher position than those of Murphysboro, have been so little worked that no decided opinion can be given as to the average quality of the coal which they afford, and although they may be inferior to the Murphysboro coal in quality, yet they are no doubt good enough for ordinary steam-producing and heating purposes, and will eventually prove an important addition to the mineral wealth of the county.

*Building Stone.*—The south-western portion of this county contains an inexhaustible supply of excellent building stone of various kinds, including marbles that are susceptible of receiving a high polish, and suited to the construction of elegant and costly buildings. The massive layers of silicious, subcrystalline limestone, that are intercallated in the cherty beds of the Lower Devonian series at "Bald Rock" and "Back-bone" afford some layers that are delicately colored, sometimes nealy white, or streaked with pink, yellow and blue, these colors being so blended as to have a pleasing effect on a highly polished surface. Some of these layers contain considerable chert in small nodules, but others are quite free from this pernicious material, and will dress evenly and receive a high polish. These beds have never been worked for building material, but recently a commencement has been made at "Bald Rock," and quarries will be opened, so that the extent of these marble beds may be fully determined. Specimens from this locality, brought to this city, and polished by the marble workers here, proved to be susceptible of receiving a very high polish at a moderate cost of labor.

The Onondaga and Hamilton limestones at the "Bake Oven," afford a durable material for foundations, culverts and rough walls, and some of the lower beds would probably dress well, and are so situated that they can be conveniently quarried for shipping from their outcrop at the water's edge.

The limestones of the Lower Carboniferous series, at Walker's hill, will afford an inexhaustible supply of limestone suitable for all ordinary building purposes, and those belonging to the St. Louis group, at the upper end of the hill, will furnish material for the manufacture of a quick lime of superior quality, and as this is the only locality in the county where this limestone is found, and is in close proximity to the railroad, by which the products of lime-kilns established here could be sent into the central portion of the State, where no limestones are found, and the facility with which fuel could be obtained from the coal mines of the Big Muddy, are considerations that point to this as a very desirable locality for the establishment of extensive works of this kind.

The limestones of the Chester series are generally silicious and cherty, but they are for the most part durable, and may be used for foundation walls when no better material is at hand. Some beds of this rock are so silicious as to form a very refractory fire-stone, and it has been used in the construction of fire-places and chimneys by the early settlers of the country. It is probable that some of the beds are also pure enough to be burned for lime, but they would make an article quite inferior to that from the St. Louis limestone, except for cement.

The sandstones of the Chester series, and the Conglomerate, afford some good building stone to supply the local demand in the vicinity of their outcrops. Locally, they are thin bedded and afford a good flag-stone. On Drury creek, the Illinois Central Railroad Company has opened an extensive quarry in the Conglomerate sandstone, on the north-east quarter of section 9, township 10 south, range 1 west, where the rock is quarried for building stone and for ballast for the road. About fifty feet in thickness of the sandstone is exposed here, in a bluff close to the road, about thirty-five feet of which is thinly bedded, while the lower fifteen feet is in tolerably heavy beds, and affords some good dimension stone. The rock is finely grained, somewhat micaceous, and of a brownish yellow color. It is rather soft when just quarried, but hardens considerably on exposure, and makes a durable building stone. In the north-eastern portion of the county, good building stone is comparatively scarce, but some of the sandstones and the limestones of the Coal Measures, which outcrop on the streams in this portion of the county, may be made available to supply the local demands for such material.

*Iron Ores.*—Iron ore in the form of a hydrous peroxyd of iron, also known as *brown hematite* or *limonite*, and the impure carbonate of iron, known as *clay iron ore*, and *kidney ore*, abound in this county; the former associated usually with the sandstones, and the latter with clay shales of the Chester series, Conglomerate and Coal Measures. The *limonite* occurs most abundantly at the base of the Conglomerate, and was especially noticed in this position at several points in section 24, township 8 south, range 4 west, and at some other points in the same vicinity. The argillaceous shales in all the groups above named, contain more or less *clay iron ore*, or *kidney ore*, disseminated through them, either in nodules or bands of septaria, crossed with veins of calcareous spar. Overlying the upper coal at Murphysboro, they form a layer in the shale from six to eight inches thick. It was nowhere seen in this county in sufficient quantity to become valuable for the manufacture of iron.

*Lead Ore.*—Galena or sulphuret of lead occurs in small quantities in the Lower Devonian limestones in the south-western corner of the county. It was found at the lower extremity of the Back-bone ridge in cutting down the hill for the railroad grade, occurring in nodular masses, from one to three inches in diameter, and coated with a thin crust of calcareous matter. It did not appear to belong to a regular vein and probably occupied pockets in the cherty limestone. The quantity found here was too small to make the discovery a matter of any economical importance.

*Saltpetre.*—This article has been obtained in Jackson county in small quantities by lixiviating the earth at the bottom of certain caves. The largest cave of this kind in the county, is situated on the lower course of Cave creek, near the north line of section 21, township 10 south, range 2 west, where the Conglomerate forms the greater part of a ridge three hundred feet high. The cave is on the east side of the creek, and is formed by an opening into the sandstone, about three hundred feet in width at the mouth of the cave, and gradually narrowing backwards for about two hundred feet to the rear end. In the central part of the cave the roof is about sixty feet in hight, gradually becoming less towards the rear, where the gradual rising of the floor and the depression of the roof form the terminus of the cavern. This cavern has no doubt been the resort of wild animals for ages, seeking shelter there in summer from the scorching rays of the sun, and in winter from the cold, just as the domestic animals do at the present day, and in this way the earth at the bottom of the cave became impregnated with the animal matter from which the saltpetre is ultimately obtained.

*Chloride of Sodium.*—Salt was formerly manufactured in this county near Brownsville, the old county seat. The well was on the bank of the Big Muddy river, three and a half miles below Murphysboro, on the south-east quarter of section 2, township 9 south, range 3 east, and was three hundred feet in depth. There was formerly a salt-lick at this point, and after finding more indications of salt by sinking a well a few feet in depth, Mr. PIERCE obtained a charter in 1824, and commenced operations by boring to the depth of 300 feet, when he obtained a plentiful flow of brine. A copper tube was inserted to keep out the fresh water which filtered through the sandstones, but as the boring had not been carefully made, the hole was not perfectly straight and round, and considerable difficulty was experienced in keeping the well free from surface water, which weakened the brine. Notwithstanding the defective tubing the well yielded one bushel of salt to one hundred and seventy-five gallons of brine, and with the best tubing that could be put in under the circumstances, the yield was increased to one bushel of salt to one hundred and twenty-five gallons. The salt was said to have been quite free from foreign mineral substances, leaving scarcely any insoluble matter in the pans. In 1830 or 1832, operations were stopped in consequence of the weakening of the brine from the defective tubing. About 1830 a new well was commenced a mile lower down the river, and at a depth of two hundred and twelve feet a strong brine was obtained, but only a small quantity. The boring was continued to the depth of three hundred and sixty-seven feet and then abandoned. The report states that this depth was entirely through sandstones, but this statement seems hardly probable, for a boring to that depth at this point must have penetrated to the limestones of the Chester series. A spring of weak brine is still running near the opening of the old well at the rate of two hundred gallons an hour.

The salt wells at Syracuse, New York, which supply a large portion of the trade of the western country, yield a bushel of salt to the hundred gallons of water, and we see no reason why, with a proper tubing, the Brownsville salt well could not be profitably worked, considering the abundance and cheapness of fuel, both wood and coal, in this vicinity. The geological horizon from which the brine is obtained here, appears to be at the junction of the Conglomerate sandstone with the Lower Carboniferous series, which is probably the principal brine-producing horizon in this State. Salt-licks also occur on the Columbo, in this county, and experiments should be made to determine if they indicate the existence of a valuable brine at this locality. With the recent improvements in boring, an experimental well could be sunk to the depth of from three hundred to five hundred feet, or down to the Lower Carboniferous limestones, at a comparatively moderate cost, as nearly the whole distance would be through soft sandstones and shales, and if properly conducted would thoroughly test the question as to the value of the brine at either of the above named localities.

*Sand and Clays.*—Sand and clay for the manufacture of brick is abundant, and may be found in almost every neighborhood where such building material is required. A good potter's clay, or a clay suitable for the manufacture of fire brick, is more rarely found, and none such was met with during our examinations in this county, but as such beds frequently occur in the Lower Coal Measures, it is quite probable that they will hereafter be found as the workable coals are more generally developed, and the clays associated with them are better known.

*Agricultural Resources.*—The general character of the bottom lands in this county has already been alluded to, and we will proceed to describe briefly the uplands, commencing with the river bluffs and region immediately adjacent thereto, that is underlaid by the Conglomerate sandstone and surbordinate limestones.

This region includes a belt of country from six to eight miles in breadth, running parallel with the river bluffs, in a general direction from north-west to south-east, and comprises about one-fourth of the whole area of the county. It is for the most part exceedingly broken and hilly, with very little arable land, except on the narrow ridges, where small farms have been opened, extending frequently into the more broken lands on either side. Along the river bluffs the soil is formed in part of the sandy loam of the *Loess*, and is deep and rich where the surface is tolerably level, and farther back, where this formation is wanting, the ridges are covered with a light-brown sandy soil, derived mainly from the decomposition of the underlying sandstones. Farther back from the river bluffs the soil is underlaid by a subsoil of stiff clay, succeeded by sand and gravel of the Drift period. These ridges are heavily timbered with yellow poplar or tulip tree, white and black oak, pig-nut and scaly-bark hickory, barren hickory, black walnut, sugar maple, black gum, sassafras and hazel, and a few post-oaks are also found in this region, where the soil is thin. The wheat and corn crops on these ridges are generally less in their yield per acre than along the foot of the bluffs on the high bottoms, but the grain is heavier and the crop less subject to failures, and it is quite probable that with a better and more thorough system of cultivation, these lands would prove to be quite as productive as any of the uplands in the county. Fruit trees and vines grow finely on these broken lands, and the fruit is less liable to be killed by the late frosts in spring than that planted in the valleys, and the peach never fails entirely on the high ridges in the southern portion of this county, and its cultivation has come to be one of the most important pursuits of the agriculturist in this region. Chicago and other north-western markets are now mainly supplied with this delicious fruit from this and the adjoining counties, and the favorable position of this region in regard to climate, and its accessibility to the north-western markets, renders it an exceedingly desirable locality for the practical fruit-grower. Grape culture has already been commenced here, and although partial failures have resulted from planting Catawbas, and some other varieties that are peculiarly liable to mildew, yet it must eventually succeed with the more hardy varieties.

The north-eastern part of the county, embracing the region north of Murphysboro and Carbondale, and east of the dividing ridge which runs in a due north-west course from Murphysboro to the north-west corner of the county, is underlaid by the Coal Measures, and has a comparatively level or gently rolling surface. At some points the country assumes the "barren" character more conspicuous farther north, and which will be more fully discussed in the report on Perry county. This "barren" soil is an extremely fine, whitish, arenaceous loam, and the characteristic timber is post-oak. The regular post-oak flats of Perry county extend also into the northern part of Jackson county, but they only occupy a limited area, and the adjacent lands are more undulating, and the timber consists in part of black-jack, black-oak, barren hickory and hazel, and on the more broken portions we find white-oak, hickory and black-gum. These lands are apt to suffer more from drought than the white-oak and poplar lands of the hilly region above described, but a more thorough and deep cultivation of the soil will probably remedy this defect, and render these lands quite productive.

Between Muddy river and Carbondale there is a wide stretch of flat land forming a level valley several miles in width, which is quite wet in consequence in part of its level surface, but more from the fineness and retentive character of the soil, which prevents a free drainage of the surface. This land is now generally neglected, and considered too wet for cultivation, but when once thoroughly broken with the plow it soon becomes dry by allowing the surface water to pass down into the more porous sub-soil below. These flat lands are heavily timbered with swamp white-oak, scaly-bark and other hickories, black-walnut, red, blue-bark and water-oak, ash, horn-beam, red-bud, pawpaw, etc.

This county lies upon the extreme southern border of the prairie region, and some small prairies are found within its limits, among which are the following: Virgennes prairie, Cox's prairie, Manny's prairie, Elk prairie, and a part of Six-Mile prairie, which is mostly in Franklin county. The prairie soil consists of a finely-comminuted, chocolate-colored, arenaceous material, which, in consequence of its fineness, assumes the appearance of clay. It is usually of a yellowish-gray or chocolate color, according to the amount of vegetable humus it contains, and from one to two feet deep. The sub-soil consists of a reddish-yellow clay stratum or hard-pan, tough and very hard to break up, almost impervious to water, and decomposes slowly when exposed at the surface, but does not form a good soil. The hard-pan is not found everywhere near the surface, but at some points there is a yellowish clay sub-soil beneath the prairie, which forms a fertile soil when fully exposed to atmospheric influences.

At many points the prairies, without any change of surface level, are surrounded by post-oak flats, which gradually change into "barrens" and post-oak hills. Some of these flats have the white, impalpable, arenaceous soil which characterizes the post-oak and black-jack flats, and are exclusively timbered with these two varieties. North-east of DeSoto we find some similar lands, although the soil is not generally quite so white, and the post-oak becomes more vigorous in growth and less numerous, or is entirely superseded by hickory, black-oak and other varieties of timber, when the surface becomes more undulating. On the whole, the agricultural resources of this county will compare favorably with any of the adjoining counties, and but for the prevalence of the milk-sickness, which has always prevailed to some extent in this portion of the State, this county would now be one of the foremost in southern Illinois in wealth and population. But this much dreaded disease will probably disappear as the surface of the country is brought under cultivation, and settlers even now find but little difficulty in protecting their cattle from its ravages by confining them to cultivated pastures, instead of allowing them to range at will through the forests.

# CHAPTER V.

## PERRY COUNTY.

Perry county lies immediately north of Jackson, which forms its southern boundary, and is bounded on the west by Randolph, on the north by Washington, and on the east by Franklin and Jefferson counties. It embraces a superficial area of twelve townships, or 432 square miles, about three-fourths of which was originally covered with timber. The principal streams within its limits are Little Muddy, Beaucoup and Columbo creeks; all of them the north-western affluents of the Big Muddy river. The surface of the country is generally rolling, and on some of the streams becomes considerably broken by low ridges, but not sufficiently abrupt to render the land unfit for cultivation; while some portions are quite level, including some flat prairies and a portion of the timbered land known as "post-oak flats." The Beaucoup traverses the county from north to south, nearly through its center, and the prairies occupy mainly the highlands between this stream and the Little Muddy on the east, and Columbo on the west, except the "Grand Coti prairie," which occupies an elevated ridge in the north-western part of the county. The prairies here, as is usually the case in other portions of the State, occupy the highest ground, but their relative elevation is quite variable, even in a single county. In this county they are mostly surrounded by timbered flats, which gradually pass into more broken timbered lands as we approach the streams. Their surface is generally flat, or gently rolling, passing locally into the broken grassy upland, known as "barrens."

The geological formations of this county are restricted to the Coal Measures and the superficial deposits known as drift. The Coal Measure strata that formed the original surface in this region, before the drift was deposited upon them, consist mainly of arenaceous, argillaceous and bituminous shales, fine grained sandstones, and thin beds of silicious and argillaceous limestone, and these rocks seem to have furnished a large part of the material of which the drift is composed. Hence the soil and sub-soil of this region is arenaceous, with a smaller admixture of clay, and the material exists in a high state of comminution, a part of it, at least, being reduced to an almost impalpable powder. This physical condition produces certain characters in the soil, which might be supposed to belong only to a stiff clay. When quite dry it rapidly absorbs water, but after having been moist for some time it becomes almost impermeable, the minute particles of the mass filling all the pores between the larger grains, and closing them so effectually that water is prevented from passing through, and remains upon the surface until it is evaporated. If this soil is mechanically worked when thus saturated, it becomes exceedingly tenaceous in consequence of the adhesive power of the minute particles of which it is in part composed, and appears to be far more clayey than it really is. Generally it crumbles readily when dry, and then shows its sandy character. It is not retentive of moisture, but in a dry atmosphere it readily gives off the water it has absorbed, and re-absorbs the moisture of the atmosphere more slowly and in less quantity than a clay soil does. Occasionally the sub-stratum is found to be a stiff, rough clay, and at other points, sand. In digging wells on the prairie lands, water is frequently found at a depth of ten feet, and is seldom deeper than thirty feet, and is usually obtained in the drift deposits before reaching the stratified rocks.

The "post-oak flats" are nearly level stretches of upland, which are very sparsely timbered, with post-oak, (*Quercus obtusiloba*), of sturdy growth, standing far apart, and interspersed with black-jack (*Quercus nigra*), and young post-oak. They form an open forest, and the nearly white soil is but scantily covered with vegetation. The sub-soil is the finely comminuted, white, sandy loam, already described as forming the soil of the adjacent prairies, and reaches to the depth of several feet. The upper soil is quite shallow, and seems to be distinguished from the sub-soil only by a slight admixture of vegetable mould. This soil, like that of the prairies, is so finely comminuted as to render it almost entirely impermeable to water, which stands in the depressions upon the surface until it slowly disappears by evaporation. At such localities we find pin-oak, scaly-bark hickory, and sometimes laurel-oak, associated with the post-oak and black-jack. These "flats" extend around the prairies, forming a narrow belt between them and the more broken timbered lands adjacent, and also form the highest portions of the broad flat ridges between the streams where no prairies occur. The principal difference between the prairie soil and that of the "flats" consists in the former being more charged with vegetable humus, and being also somewhat deeper than it is upon the "flats."

The "barrens," as that term is understood in this region, consist of low hills and ridges, covered with a dense growth of tall grasses, and quite destitute of timber, or with only a few scattering trees. The sub-soil on these "barrens" is similar to that above described, and consists of the same white sandy loam, but their surface-configuration affords a complete drainage, and they have therefore sustained a better growth of vegetation, which has formed a few inches of good soil, highly charged with humus. The "barrens" become dry early in the spring, from their better surface drainage, and resist the drouth better than the "flats," because the soil is more porous, and absorbs more moisture from the atmosphere. The absence of timber on them appears to be due to the annual fires that sweep over them, fed by the tall grasses that cover the surface, a conclusion that is sustained by the fact that as the country is settled, and the fires are kept out, a vigorous growth of young trees soon covers the surface. The "barrens" merge into the post-oak hills, which are similar ridges, covered with a heavy growth of timber, consisting in part of post-oak, with black-oak, black-jack, hickory, etc. The white-oak is confined mainly to the breaks of the streams.

The principal creek bottoms within the barren region have a soil very similar to that of the flats, but a little coarser, and containing a greater per cent. of vegetable mould, rendering them as dark colored as the prairie soils. The timber is very tall and heavy, and consists principally of the swamp white-oak, pin-oak, bur-oak, red-oak, laurel-oak, scaly-bark, hickory, ash, black-walnut, hazel, etc.

The character of the upland country above described does not extend very far to the southward beyond the limits of this county, but it includes a limited area in the north-eastern part of Jackson county, and from thence extends south-eastward into Franklin and Williamson counties.

Of all these varieties of soil, the "flats" are the most unproductive, and will require the greatest amount of labor and skill to bring them up to the highest standard of a good productive soil. This can be done most effectually and cheaply by deep and frequent plowing, which loosens the soil and assists the surface drainage, and by manuring, and plowing under green crops to give the required amount of vegetable mould, and this treatment would probably insure a steady increase in the productive capacities of the soil, until it equaled or perhaps exceeded that of the adjacent prairies.

The drift deposits in this section of the State are comparatively thin, seldom attaining a thickness of more than thirty or forty feet, and our knowledge of their general characters has been derived from the examinations of wells that have been sunk in various parts of the county for water, and from cuts along the Illinois Central Railroad. Here, as elsewhere over the central and southern portions of the State, they consist of beds of clay, sand and gravel, partially stratified, and varying both in depth and arrangement of materials at almost every point where they are penetrated. A well sunk on the north-west quarter of section 16, township 6 south, range 4 west, gave the following section:

| | | | | |
|---|---|---|---|---|
| Soil and sub-soil | 3 | feet. | | |
| Reddish clay | 14 | " | | |
| Sand and gravel | 2 | " | 6 | inches. |
| Yellow, tough clay | 10 | " | 6 | " |

This section will give an idea of the general character of these deposits, although probably no two wells would afford exactly the same section. Below these beds we find at some localities the same "blue mud" already alluded to in the foregoing chapter, as occurring in a similar position in Jackson county, while at others, wells are sunk to the stratified rocks of the Coal Measures without meeting with it. Hence we may infer that it was either a local deposit, that accumulated only in ponds or sloughs, or else it was in part swept away by surface erosion at the commencement of the drift period. Its average thickness can not be definitely stated, for when it was found in digging for water, the well was generally abandoned as soon as this deposit was reached, because the partly decomposed vegetable matter which it contains rendered the water unfit for use. It appears to be composed, in good part, of vegetable matter, consisting of leaves and partially decayed wood, embedded in a muddy sediment, and has been penetrated at some places to the depth of five to ten feet. It has been found at the following points in this county: At Crawford's mill, on Pipe-stone creek, on section 33, township 6 south, range 3 west; at Mr. Andrew Brown's, on the western edge of Six-Mile prairie; at Old DuQuoin, on section 26, township 6 south, range 1 west, and at a saw-mill on a branch of Swanwick creek, on section 15, township 4 south, range 3 west. It usually lies at the bottom of the drift deposits, but at one point in Jackson county it was underlaid by a bed of sand two or three feet in thickness. This sand, as well as the blue mud above it, probably belongs to a period somewhat older than the true drift deposits, and it is very important that wherever these beds are penetrated in sinking wells, or are otherwise exposed, a careful examination should be made for any organic remains that they may contain, as these would no doubt throw some light upon their true origin, and the conditions under which they have been deposited.

## *Coal Measures.*

All the stratified rocks that outcrop at the surface in this county belong to that division of the Carboniferous system usually known as Coal Measures; so called because they contain all the coal-seams of any practical value that are found in the rocks of this age. They embrace an aggregate thickness of nearly three hundred feet, and consist mainly of soft sandstones and shales, thin beds of limestone, bituminous slates and coal, and include the horizon of two of the principal coal-seams at present known in the Illinois coal-fields. These coals are associated with the only limestones of any importance that are found in the county, and consequently their outcrop is more readily defined and more easily traced than that of the soft shales and sandstones that form the upper two hundred feet of the section. The principal outcrops of these limestones, and the beds associated with them, are along the southern and eastern borders of the county, and they dip gently to the north-eastward, at the rate of about eight to ten feet per mile, so that the beds which outcrop along the streams in the southern part of the county are two hundred feet or more below the surface in the northern part. This has been fully determined by the various coal shafts sunk along the line of the Illinois Central Railroad, in this county, and from these we have been enabled to obtain a very complete section of all the beds which outcrop in this county above the DuQuoin coal. This coal is probably the equivalent of No. 5 of the general section, (see chapter 1, p. 5), but this is a point we have not yet been able to determine positively. This coal, No. 5, and that above it, No. 6, have so many features in common, that, where but one is developed, it is frequently difficult to say to which horizon it belongs. But, from the best evidence we have been able to obtain, we are inclined to the opinion that the DuQuoin coal should be referred to No. 5, and the small seam above, which ranges in thickness in this county from a few inches to three feet, is really the equivalent of No. 6, or the Belleville coal. The following section gives the relative position and thickness of the beds outcropping in this county. The data for the upper portion of this section was obtained from the shafts at Coloma and Tamaroa:

| | | |
|---|---|---|
| Soft micaceous sandstone | 15 feet. | |
| Sandy shale | 20 ‘‘ | |
| Massive hard ferruginous sandstone | 10 ‘‘ | |
| Blue clay shale | 20 ‘‘ | |
| Impure iron ore, with fossil shells | 2 ‘‘ | |
| Bituminous shale | 3 ‘‘ | |
| Coal, No: 8 | 0 ‘‘ | 9 inches. |
| Fire clay | 3 ‘‘ | |
| Sandstone | 15 ‘‘ | |
| Sandy shale, with some kidney-ore in the lower part | 102 ‘‘ | |
| Hard calcareous sandstone | 3 ‘‘ | |
| Black carbonaceous slate passing into coal No. 7 | 1 ‘‘ | 6 inches. |
| Clay shale | 3 ‘‘ | |
| Hard, arenaceous, slaty rock | 16 ‘‘ | |
| Clay shale | 7 ‘‘ | |
| Light gray, hard, sub-crystalline limestone | 7 to 9 ‘‘ | |
| Bituminous shale | 1 to 2 ‘‘ | |
| Coal, sometimes wanting—No. 6 ? | 1 to 3 ‘‘ | |
| Fire clay or clay shale | 3 to 4 ‘‘ | |
| Limestone, light colored and arenaceous | 7 ‘‘ | |
| Gray shale | 6 ‘‘ | |
| Limestone | 6 ‘‘ | |
| Shales, with fossil plants | 15 to 25 ‘‘ | |
| Coal, No. 5 ? | 5 to 7 ‘‘ | |
| Clay shale, with nodules of hard limestone | 15 ‘‘ | |
| | 305 feet 3 inches. | |

Below the beds represented in the above section, there are still at least two hundred feet of strata belonging to the Coal Measures, and containing three or four coal-beds in Jackson county, as well as in northern and central Illinois, that range from two to five feet in thickness; all of which probably underlie the entire area of this county, and crop out in the adjoining counties to the south and south-east, while to the west they thin out to less than a hundred feet in thickness, and contain little or no coal of any practical value. All the coals described in the foregoing chapter, as outcropping in Jackson county, underlie those represented in the foregoing section; but they may not be developed in this county so as to be of economical importance.

The coal ("No. 6 ?") in this section outcrops on the western borders of the county, on the eastern edge of Six-Mile prairie, with a thickness of three feet and two miles farther north there is another outcrop, apparently of the same seam, where the coal is only eighteen inches in thickness. In the vicinity of DuQuoin this upper coal has been found at many points, ranging in thickness from two feet down to a mere streak of coaly matter.

At the Black Diamond mine, north of St. John's, the coal shaft was sunk through the following beds:

| | | |
|---|---|---|
| Clay (surface material) | 24 | feet. |
| Limestone | 9 | " |
| Soap-stone (clay shale) | 1 | " |
| Bituminous shale | 1 | " |
| Coal | 1 | " |
| Fire-Clay | 4 | " |
| Limestone | 6 | " |
| Clay shale | 5 | " |
| Limestone | 7 | " |
| Blue clay shale | 15 | " |
| Hard, dark-colored rock (limestone ?) | 8 | " |
| Bituminous shale | 2 | " |
| Coal | 5 | " |
| | 93 | feet. |

The Eagle shaft, between the Black Diamond and St. John's, commences at a level below the upper seam, and the shaft passed through the following beds:

| | | |
|---|---|---|
| Drift clay | 10 | feet. |
| Soft fire-clay | 6 | " |
| Shales | 15 | " |
| Limestone | 6 | " |
| Shales | 10 | " |
| Coal | 6 | " |

Three-quarters of a mile east of the Black Diamond shaft, the little coal-seam is exposed on Reese's creek, below a compact gray limestone. The coal is here about twenty inches thick. Farther down on this creek, and nearly east of St. John's, we find another outcrop of apparently this same coal, where it is considerably thicker, and was worked by drifting at an early day; but the coal appears to have been rather poor in quality, and the work was soon abandoned. At Mr. ARCHIE WILSON'S place, five miles south-east of DuQuoin, the limestone forming the roof of the coal outcrops on a small creek near his dwelling, and has been burned for lime. The coal, which is here two feet thick, has been mined by stripping in the creek bottom, and, judging from the small fragments left upon the surface, where it had been deposited as it was taken out of the mine, it appeared to be of good quality.

At Pinckneyville, the limestone overlying the small coal was found twenty feet below the surface, on the public square, and was penetrated to the depth of five feet without reaching the bottom. At Owen's coal shaft, adjoining the town, the following beds were passed through:

| | | |
|---|---|---|
| Soil, yellow clay, etc., (Drift) | 16 feet. | |
| Quick-sand | 1 " | |
| Light gray limestone, underlaid by a faint streak of coal | 1 " | |
| Argillaceous shale | 14 " | |
| Compact blue limestone | 6 " | |
| Bituminous shale | 0 " | 10 inches. |
| Coal | 6 " | |
| Clay shale, with calcareous nodules | 5 " | |
| | 49 feet | 10 inches. |

This is probably the DuQuoin coal, and it outcrops and has been worked on a ravine south-east of the town, in section 30, township 5 south, range 2 west. A half mile north-east of town, the coal crops out on the Beaucoup; and several shafts have been sunk to the coal at this point. The bituminous shale, overlying the coal, is here several feet in thickness, and is overlaid, as above, by the blue limestone, which, a little higher up, forms a shoal across the bed of the creek. There seems to be an undulation in the strata here, which brings the main coal above the creek level, just at the town, while it dips below that level above and below. On Beaucoup creek, below Pinckneyville, but few outcrops are found, but enough to show that the coal extends nearly or quite to the county line of Jackson county; and it is quite possible that the coal noticed in the report on that county, as outcropping near the north line of the county, will prove to be the DuQuoin coal.

Near the north line of section 6, township 6 south, range 2 west, the following beds may be seen, outcropping below the Drift clays:

| | | |
|---|---|---|
| Calcareous shale | 1 foot. | |
| Blue limestone | 2 to 4 feet. | |
| Bituminous shale | 0 " | 5 inches. |
| Coal | 6 " | |
| Clay shale | 5 " | |

Coal has been found in various localities in this neighborhood, in sinking wells, and the overlying limestones and shales outcrop at various points. At the Creek Pond bridge, on the south-west quarter of section 29, the coal crops out in the bank of the Beaucoup, and is overlaid by three feet of bituminous shale. The coal is reported to be from six to seven feet thick at this locality. From Pinckneyville southward, along Beaucoup creek, the coal varies but little from the level of the creek, and may be mined almost any where within thirty or forty feet of the general surface level.

In the region west of the Beaucoup, and extending to the west line of the county, very few outcrops of rocks of any kind are to be seen, as there are no streams that cut through the superficial clays to the stratified rocks below; but the coal and the overlying limestone and shale have been found at many points in sinking wells, and they underlie the surface, generally, except where they have been removed by the erosion of the valleys. South-west of Pinckneyville, on the Little Columbo creek, and at various points in township 6 south, range 3 west, the limestones have been found at a moderate depth below the surface, in sinking wells. On sections 14 and 15, the limestone was found about fifteen feet below the surface; and, in the east part of section 9, it outcrops in the banks of the creek, and continues to outcrop, as we ascend the creek, for half a mile or more. On the lower course of the creek, it was not met with. Farther west, on a branch in section 4, and in a ravine on the prairie in the south part of section 3, and the north part of section 10, outcrops of the limestone were seen; and, on section 4, it forms the bed of the creek, and is overlaid by from six to twelve inches of argillaceous shale, and about six inches of coal, probably representing the three-foot coal in the section already given on a preceding page; and this is overlaid by several feet of argillaceous shale, which appears to be fine enough for the manufacture of fire-brick. Higher up the creek, there are some outcrops of shaly, micaceous sandstone, which occupy a horizon above the limestones associated with the coal-seams, and may be regarded as belonging to the Upper Coal Measures.

On the main Columbo creek, there are no exposures on its lower course in this county; and it is bordered by wide stretches of low bottom land. The first outcrop of the limestones on this creek, is on section 18, township 6 south, range 3 west; and they again appear on section 12. The shaly limestone and calcareous shales at the Slate-ford, on the south-west quarter of section 1, and at the ford on the north-west quarter of section 2, also belong to this limestone series, and are overlaid by heavy masses of tumbling limestone, from three to six feet thick, that probably belong to the bed above the little coal. These outcrops afford a sure indication of the presence of the main coal, over this portion of the county, at a very moderate depth below the surface. On the north-east quarter of section 3, township 6 south, range 4 west, a seam of coal, capped by a little blue shale, has been discovered underneath an outcrop of limestone, which appears here in two beds, each about eight feet thick. The coal is reported to be about three feet thick, and probably holds the same position as the thin streak of coal at Pinckneyville, and the little seam near St. John's. The same coal crops out about one mile north-east of this point, on the south-west quarter of section 34, township 5 south, range 4 west, and is overlaid by the same beds as at the former locality. The coal was reported to be three feet thick here, and was used for burning lime from the overlying limestone. On section 28 there is another outcrop of the same coal. It is here only eighteen inches thick, and is overlaid by bituminous shale and limestone, as at the other localities. It is underlaid by fire-clay, or clay shale, twenty inches thick, and by limestone similar in character to that above it.

At JAMES McMILLAN'S, on the north-east quarter of section 10, township 6 south, range 4 west, coal was found in his well, two feet in thickness, between two beds of clay shale, the overlying limestone having been removed by denudation. In township 5 south, range 4 west, the limestone above this thin coal is exposed in a ravine, on section 32, and was struck in a well, at the foot of the mound near the south line of section 32, at a depth of from twelve to fifteen feet below the surface. There are two of these *mounds* in this vicinity, and they rise out of the surrounding prairie to the hight of sixty to eighty feet, like islands from the sea. They appear to have been formed by the irregular erosion of the surface, anterior to, or during the Drift period, and are formed mainly of sandstones, shales, etc., that belong to a horizon above the limestones that are associated with the main coal-seams in this county. One of them is covered with timber, but the other has several farms upon it, and, from the wells and cisterns that have been dug, the following section of its strata has been compiled:

| | | |
|---|---|---|
| Soil and clay, forming the summit | 7 feet | |
| Soft sandstone and shales | 42 " | |
| Coal | 1 " | 6 inches |
| Argillaceous shale, passing into sandy shale | 9 " | 6 " |
| Ferruginous sandstones, in thin layers | 2 " | |
| Sandstone and shale, at least ten feet, perhaps more | 10 " | |
| Compact light-gray limestone, not passed through | ? " | |

On Pipe-stone creek, a mile south of Denmark, the limestone and shale of the lower coal are exposed. At Mr. AYERS', near the bridge, on section 16, two wells were dug; and the main coal was found at a depth of thirty-eight feet.

At Mr. S. HOLLIDAY'S, on the southern border of Grand-Coti prairie, a well was sunk, passing through the following strata:

| | | |
|---|---|---|
| Soil and tough red clay | 19 feet | |
| Shaly sandstone, passing into argillaceous shales, with concretions of iron ore | 32 " | |
| Blue shale | 3 " | |
| Coal | 1 " | 6 inches |

This coal is probably the same as that passed through on the mound, and lies above all the limestones associated with the DuQuoin coal, and is probably No. 7 of the general section. These beds underlie all the northern portion of the county, and, having a slight general dip to the north-eastward, are far below the surface at the northern line of the county, and are succeeded by higher beds of sandstone and shale. These barren measures cover all the northern portion of the county, to depths ranging from one hundred to two hundred feet, and must be passed through before any workable coal can be reached. The sandstones and shales outcrop on all the streams in the northern part of the county; and some of the beds are sufficiently hard to withstand surface exposure, and form low cliffs of sandstone on some of the small streams.

Returning to the south-eastern part of the county, we find coal on the bank of Span's creek, close to the county line; but, as it was not opened when we visited the locality, its thickness can not be definitely stated. It is variously reported at from two and a half to four feet. Partial outcrops of sandstone and silicious limestone were observed in connection with this coal, and apparently overlying it. It is probably the same as that found at Archie Wilson's place, five miles south-east of DuQuoin, and most probably represents the three-foot coal in the general section of the Coal Measures of this county. At Wilson's, the coal is but two feet thick; and the rocks associated with it give the following section:

| | |
|---|---|
| Light-gray or brownish-gray massive limestone | 6 feet. |
| Irregularly bedded bluish-gray limestone | 2 '' |
| Clay shale | 1 '' |
| Coal | 2 '' |
| Clay shale | 1 '' |
| Sandy shale, passing into sandstone | ? '' |

The limestone above this coal appears to be identical with the upper bed in the Pinckneyville section, and the coal the same as that on Span's creek, and the two-foot coal in the Black Diamond shaft. The limestone is hard, compact, somewhat brittle, and hard to burn, but makes a strong, though somewhat dark-colored lime. In the bottom on Six-Mile creek, near the county line, in Jackson county, limestone has been struck in a well, thirty feet below the surface, which is probably the limestone immediately above the DuQuoin coal. The following sections of the shafts at DuQuoin and St. John's are given to illustrate the variations that occur in the beds associated with the DuQuoin coal, and the unevenness of the surface before the Drift was deposited, as is shown by the variable thickness of these deposits on what is now a nearly level surface:

*Shaft at St. John's.*

| | |
|---|---|
| Soil and drift clays | 43 feet. |
| Gray compact limestone | 8 '' 6 inches. |
| Indurated clay shale | 4 '' 6 '' |
| Compact gray limestone | 2 '' 6 '' |
| Bituminous shale | 5 '' 6 '' |
| Arenaceous and argillaceous shales | 16 '' |
| Coal | 6 '' 4 '' |
| Clay shale, with iron pyrites | 4 '' |
| | 85 feet 4 inches. |

*DuQuoin Central Mine.*

| | |
|---|---|
| Soil and drift clay | 29 feet. |
| Blue clay shale | 8 '' |
| Compact gray limestone | 5 '' 8 inches. |
| Dark blue shale | 5 '' 6 '' |
| Coal | 6 '' |
| Clay shale, with iron pyrites | 2 '' 6 '' |
| Compact nodular limestone, embedded in clay shale | 5 '' |
| | 62 feet 8 inches. |

### *Mill Shaft — DuQuoin.*

| | | |
|---|---|---|
| Soil and drift clays | 32 feet | 5 inches. |
| Hard gray limestone | 7 " | 1 " |
| Argillaceous shale | 8 " | 11 " |
| Black limestone | 0 " | 9 " |
| Shales — argillaceous | 17 " | 7 " |
| Coal | 6 " | 6 " |
| | 73 feet | 3 inches. |

### *DuQuoin Mine.*

| | | |
|---|---|---|
| Soil and drift clay | 40 feet. | |
| Argillaceous shale | 20 " | |
| Coal | 6 " | 7 inches. |
| Clay shale | 1 " | 3 " |
| Nodular gray limestone, embedded in shale | 4 " | |
| Argillaceous shale | 2 " | 6 " |
| Limestone | 0 " | 10 " |
| Argillaceous shale | 3 " | 6 " |
| | 78 feet | 8 inches. |

### *Wall's Colliery.*

| | | |
|---|---|---|
| Soil and drift clay | 19 feet. | |
| Gravel and waterworn limestone | 1 " | |
| Gray limestone, with clay partings | 6 " | |
| Shales | 5 " | |
| Limestone | 0 " | 6 inches. |
| Shales, with calcareous nodules | 4 " | |
| Hard light-gray limestone | 2 " | |
| Bituminous shale | 2 " | 6 inches. |
| Argillaceous shale | 16 " | |
| Coal | 6 " | |
| | 62 feet. | |

A boring by Mr. Tijou, at this shaft, gave the following section below the coal seam:

| | | |
|---|---|---|
| Fire clay, with nodules of limestone | 15 feet | 10 inches. |
| Gray and blue shales | 46 " | 6 " |
| Bituminous shale | 4 " | 6 " |
| Coal | 0 " | 9 " |
| Fire clay | 5 " | 5 " |
| Gray shale | 8 " | 4 " |
| Sandy shale and sandstone | 81 " | 6 " |
| Limestone | 2 " | 7 " |
| Bituminous shale | 1 " | 3 " |
| Coal | 0 " | 6 " |
| Fire clay | 3 " | 9 " |
| Clay shale | 17 " | 1 " |
| Micaceous sandstone | 0 " | 10 " |
| Depth of boring | 188 feet | 10 inches. |

At this point, the work was suspended in consequence of breaking the drill; but it is the purpose of the enterprising proprietor to prosecute it, until the question is settled whether any of the lower seams are developed here thick enough to work. It is probably from one hundred and fifty to two hundred feet from the DuQuoin coal down to the lower coal at Murphysboro; and the determination of its existence below the DuQuoin coal in Perry county, under such favorable conditions that it could be worked at this point, is a matter of considerable importance to this county, and would justify such an expenditure of capital as is necessary to fully settle this question.

From the sections already given of the beds associated with the coal at Pinckneyville and DuQuoin, it will be seen that there are three, and sometimes four, different beds of limestone above the main coal, ranging in thickness from two to ten feet, and separated by argillaceous, calcareo-argillaceous, or bituminous shales. The upper limestones are usually of a light-gray or brownish-gray color, quite hard and tolerably massive, affording layers from one to three feet in thickness. They contain numerous fossil shells at some localities, among which are *Spirifer cameratus*, *S. lineatus*, *Productus Prattenanus*, *P. longispinus*, *P. punctatus*, *P. Wilberanus*, *P. costatus* (?), *Athyris Royissii*, *A. subtilita*, *Chonetes mesoloba*, *C. granulifera*, *Meekella striatocostata*, and joints of *Crinoidea.*

The clay shale, which lies immediately above the main coal, and forms the roof, contains a variety of fossil plants, among which the following species have been obtained at DuQuoin and St. John's, with others still undetermined: *Neuropteris rarinervis*, *Sphenopteris paupercula*, *Alethopteris aquilina*, *Pecopteris villosa*, *P. unita*, *P. plumosa*, *Cordaites borassifolia*, *Sphenophyllum Schlotheimii*, *S. emarginatum*, *Asterophyllites equisetiformis*, *Calamites ramosus*, *C. cruciatus*, *C. approximatus*, *Sigillaria sculpta*, *S. Brardii*, *Lepidodendron radicans*, *Lepidostrobus princeps*, *Megaphytum McLayi*, and *Caulopteris insignis.*

It is worthy of remark here that the fossil shells which characterize the upper limestones of DuQuoin and Pinckneyville, as enumerated above, are precisely the same species that are found in the roof limestones of the Belleville coal in St. Clair, Madison and Randolph counties; while no plants have been found in the roof shales of that coal at any of the many localities where we have seen it exposed in the counties above named; and furthermore, we have never seen any such bed of clay shale over the Belleville coal, along its western outcrop, as that which affords the fossil plants at DuQuoin and St. John's, and, if the coals are identical, we must regard this clay shale, with its imbedded plants, as a local intercalation that has not been seen at any of the typical localities of the Belleville coal. Hence, we are inclined to doubt the identity of these coals, and to consider the DuQuoin coal as identical with the Howlett coal, or No. 5 of the general section of the Illinois coal-beds; and, if so, then the Belleville coal would be represented by the little coal that is intercalated in the upper limestones of the Pinckneyville and Black Diamond sections, and this view is confirmed by the fact that this upper coal is considerably thicker on the western confines of the county than it is along the Central railroad, being from three to four feet thick at some of the exposures near the Randolph county line; while it is nowhere more than two feet in thickness in the eastern part of Perry county, and is often entirely wanting, or is represented by a mere streak of coaly matter. As we have already said elsewhere, these two coals are developed so near together, and are associated with beds which have so many features in common, being usually not more than forty or fifty feet asunder, and inclosed between limestones closely resembling each other, so that it is difficult to determine, if but one seam is exposed, to which horizon it should be referred. In St. Clair county, both seams outcrop in the river bluffs, at the old Pittsburg mines; but, as the lower one is much thinner there than the upper, or Belleville seam, no attempt has been made to determine its thickness anywhere beyond its outcrop, or to ascertain its average quality. This will no doubt be done, when the upper seam has been generally worked out, and the increased demand for fuel shall be such as to justify a thorough exploration of the entire thickness of the Coal Measures in that county, for an additional supply.

But little remains to be said in relation to the barren measures in the northern portion of the county. The soft micaceous sandstones and shales are frequently met with in small local outcrops in the ravines and on the streams, and Mr. ENGELMANN mentions a single outcrop of limestone in the north-eastern corner of the county, which he refers to the Shoal-creek limestone of Clinton county. This exposure is on the north-east quarter of section 13, township 4 south, range 1 west, and, with its associated beds, affords the following section:

| | | |
|---|---|---|
| Gray shale, with nodules of iron ore | 3 feet. | |
| Hard, bluish-gray limestone | 5 " | |
| Shale | 1 " | 6 inches. |
| Dark-blue slate | 3 " | |
| Coal, said to be twelve inches | 1 " | |
| Clay shale | 6 " | |
| | 19 feet, 6 inches. | |

This limestone is not reported in the Coloma shaft, sunk just north of the county line in Washington county, or any other beds that can properly be considered as the equivalent of the remainder of this section, unless it may be the band of impure iron ore, black shale, and nine-inch coal, found about ninety feet below the surface in that shaft, which can scarcely be the representatives of this horizon. These beds are overlaid in the shaft by about sixty-five feet of sandstone and shale, and would seem to be too low down in the section to represent the Shoal-creek limestone. Local intercalations of calcareous beds are not uncommon in the Coal Measures; and it is quite probable that this limestone is of that character; or it may be that it overlies, entirely, the beds passed through in the Coloma shaft, and had been removed by erosion at that point. The Shoal-creek limestone occupies a position near the horizon of coal No. 9 of the general section of the Coal Measures of central and northern Illinois.

All the coals of this county thick enough to be worked with profit, except at some local points where the thin seams outcrop under the most favorable conditions, are those outcropping in the southern portion of the county, embracing the DuQuoin coal, the small coal above it, and the seams still below these, which outcrop in Jackson county, but have never been looked for in the region where the DuQuoin coal is found, because, as the latter occupies a much higher position in the series, it is more accessible, and can be worked at much less expense than the lower coals; but they may still be found here, and a shaft to reach them must probably be carried down to the depth of about two hundred feet below the coal at DuQuoin.

## *Economical Geology.*

*Coal.*—It will be apparent, from what has already been said in regard to the geology of this county, that its principal mineral wealth consists in the vast deposits of bituminous coal which underlie its entire area, and in the southern portion of the county are found so near the surface that they can be worked as economically as any where else in the State. The DuQuoin coal is one of two heavy beds—Nos. 5 and 6—that occur about midway in the section of the Coal Measures of this State, and are the thickest coals we have, and the most persistent in their development of any in the series, except, perhaps, No. 2, or the lower coal at Murphysboro. In the central portion of the State, where the upper or "barren" measures are well developed, and where there is no extraordinary accumulation of Drift material above the Coal Measures, it is usually found at a depth of from two to three hundred feet, which depth gradually diminishes as we approach the borders of the coal-field. In the southern part of Perry county, it is usually found from forty to eighty feet below the surface, and dips slightly to the northward, so that at the north-eastern extremity of the county, it is from two hundred to two hundred and fifty feet below the surface level.

The limestones which are associated with this coal outcrop in the ravines near DuQuoin, on the Beaucoup, from Pinckneyville, southward; on the Columbo, from the neighborhood of Galum, southward; and at numerous other points in the southern part of the county already noticed; and, wherever these outcrops of limestone occur, the coal may be found at a depth of from thirty to forty feet, requiring but a small investment of capital to put a mine in successful operation. But, at the present time, little or no demand exists for coal off from the railroad line; and, until the completion of other roads, or the establishment of manufactories in this portion of the State, these vast deposits of mineral fuel can be made of little avail.

The DuQuoin coal is of excellent quality, above the average of our western bituminous coals; and, although at some points it contains considerable sulphuret of iron, this occurs mostly in nodules or lenticular masses, and can be readily separated from the coal in the process of mining. One reason for the bad reputation which our Illinois and other western coals have in Chicago and other markets, is the want of proper care, in mining, to separate the slate and sulphuret of iron (often called "sulphur") from the coal; and consequently the coals go to market with much of these deleterious substances mingled with them, which seriously affect their commercial value. This results from the carelessness of those in charge of the work, who allow the miners to send out of the mines the entire contents of the seam, including the sulphur and the slate as well as the coal, which they are prompted to do, because it adds so much to the amount of each day's product. This coal averages fully six feet in thickness in this county, and has a good roof of hard, somewhat bituminous clay shale, which admits of taking out the entire thickness of coal, instead of leaving a portion to sustain the roof, as is usually done where the roof consists of soft material. At some points, as at Pinckneyville, the coal is directly overlaid by a hard, blue limestone, that forms a still better roof than the bituminous shale.

The coal is usually divided into distinct layers, averaging from six to twelve inches in thickness: the upper two feet of the seam, being usually considered the best coal, is often separated from the other, and sold for smiths' coal. At St. John's and DuQuoin, the difference between the top and bottom coal is less marked, and no separation is made. The sulphuret of iron occurs mostly in lumps and sheet, which can be easily separated from the coal; but there is some, occurring in very thin scales in the transverse partings of the coal, that can not be so readily separated from it: the quantity, however, is small. Some of the layers are very bright and compact, and have a resinous lustre and highly conchoidal fracture, while others are more dull and earthy and contain considerable charcoal.

An analysis of the DuQuoin coal by Mr. PRATTEN gave the following result:

| | | |
|---|---|---|
| | Specific gravity | 1.246 |
| | Loss in coking | 48.9 |
| | Total weight of coke | 51.1—100 |
| ANALYSIS— | Moisture | 8 5 |
| | Volatile matters | 40 4 |
| | Carbon in coke | 48.1 |
| | Ashes (light gray) | 3 0—100 |
| | Carbon in coal | 59.6 |

This coal-seam is subject to some irregularities, such as "clay-slips" or "horse-backs," sometimes called "faults" by the miners, which consist in a thickening of the roof shales, thus cutting off or pinching the coal-seam to one-half or three-fourths of its usual thickness. These irregularities, or "horse-backs," as they are sometimes called, may have resulted from a partial removal, by water currents, of the vegetable matter which formed the coal, and its replacement by a fine muddy sediment at a subsequent period. They are not "faults" in the sense in which that term is generally used in mining, which signifies a dislocation or displacement of the strata, so as to prevent their continuity on the original plane of deposit; for in this case there is no dislocation, but only a replacing of a part of the coal by the same material that forms the roof.

At the DuQuoin Central mine, the coal seems to differ somewhat from that obtained from the other shafts in this vicinity; and it lies about twenty feet nearer the surface than at the Mill shaft, on the same quarter-section, a half mile further north, while the general dip to the northward would not be sufficient to account for this difference of level. It is quite possible that this coal is really the upper seam, which has thickened here to five and a half or six feet, and that the other seam has not been reached at all in this shaft. By referring to the section of the shaft, it will be seen that there is only one bed of limestone above the coal, and that a similar limestone underlies it, with a foot or two of clay shale between; and the twenty feet of clay shale, which comes immediately above the coal at all the other shafts, is replaced in this one by five and a half feet of dark-colored bituminous shale. The upper layers of coal in this mine are remarkably free from all earthy matters; and the lamination is nearly obliterated: the coal has a resinous appearance, and breaks with a smooth conchoidal fracture. The bottom coal, however, is inferior, and contains thin seams of slate and iron pyrites. It is also more distinctly laminated; and the laminæ are separated by layers of carbonaceous clod, mixed with mineral charcoal.

The roof of this mine is a very firm and highly bituminous slate or shale, which is crossed by numerous fissures running nearly east and west. This slate forms a very good roof, and permits the taking out of all the coal from the mine. The coal is mined by blasting with powder at all the mines; and at the DuQuoin Central it is so compact that, after the removal of the bottom coal, a second blast is required to remove the top coal. Whether the difference between the coal at this mine and the others in this vicinity results from a local variation of the same seam, or whether it is really a different seam, is a point that we must leave to be fully solved hereafter; but it has many features in common with the No. 6 or Belleville coal, to which we are strongly inclined to refer it.

The amount of coal accessible at a very moderate depth in this county is enormous; and an estimate approximating the truth would probably astonish any one not familiar with the subject. We will base our estimate on the main seam at DuQuoin alone, leaving out of the count altogether the lower coals of Murphysboro and Carbondale, in Jackson county, which probably underlie this county also, and, calling the superficial area in the county four hundred square miles, we have the following result: Six feet in thickness of strata will yield, according to the usual mining estimates, 6,000,000 tons of coal to each square mile of surface; and for four hundred square miles we have an aggregate of 2,400,000,000 tons of coal, which, at $1 50 per ton, the average price at which it sells at this point, would yield $3,600,000,000, an amount more than sufficient to pay the whole national debt. This estimate is undoubtedly below rather than above the actual value of the coal to be obtained from the beds underlying the surface of this county alone; and its abundance, and the facility with which it may be mined, from its proximity to the surface, and other favorable conditions, which have been fully stated above, will make this a desirable location for the establishment of the necessary manufacturing establishments to work up the vast agricultural products of southern Illinois. There is probably no other county in the southern part of the State, where so great an amount of coal can be obtained with so small an expenditure of capital and labor as here; and the development of these vast resources of fossil fuel, as the increasing wants of the country shall demand, will greatly add to the industrial interests of this portion of the State. No satisfactory tests have yet been made to determine whether any of the coals from DuQuoin were sufficiently pure to smelt iron in their raw state; but it seems probable that a careful selection of the best coal from this region would lead to the accomplishment of this most desirable result, and this would bring the iron ores of Missouri to the coals of southern Illinois, to be manufactured into metallic iron. The completion of the railroad from Carbondale to Murphysboro, will give an outlet for this coal to the western bank of the Mississippi river, about a hundred miles below St. Louis, and nearly opposite one of the most accessible points on the river to the great iron region of Missouri.

At the present time, the principal market for this coal is along the line of the Illinois Central railroad; and the annual product of the mines now opened in this county, for the year 1867, was about 200,000 tons, obtained from less than thirty acres of surface. These mines pay a royalty to the land-owner of 12½ cents per ton, equal to about $25,000 for the mining privileges on about twenty-four acres of surface; and at this rate the aggregate value of the royalty to be paid to the land-owners for the coal in this county, from the DuQuoin seam alone, would be about $300,000,000.

*Iron Ores.*—Carbonate of iron is extensively distributed through the Coal Measures of this county, but generally in too limited an amount to be of much practical value. It occurs interspersed through the clay shales, in flat or kidney-shaped concretions, but seldom in a continuous body. When the streams cut through these shales, considerable quantities of ore may be seen along their courses, washed out from the banks of shale on either side, as on Swanwick creek, a short distance above the Pinckneyville and Nashville road. Similar ores are found in the shales penetrated in sinking wells on the south side of Grand-Coti prairie, and at several other points in the county; and possibly it may hereafter be found at some locality in workable quantity.

*Galena* and *Native Copper* have been found in the superficial clays and gravel beds of this county; but these minerals do not belong to this region, and have been transported from the north, at the same time and by the same agencies which brought the granite and trap boulders with which they are here associated.

*Building Stone.*—Perry county is not well supplied with good building stone: nevertheless, the limestones of the southern portion, and the sandstones of the Upper Coal Measures, which outcrop in the northern part of the county, afford material suitable for foundation-walls; and some of the limestones may be safely used for bridges and culverts. The light-gray limestone forming the roof of the little coal-seam in the vicinity of DuQuoin and Pinckneyville, appears to be a durable building stone, and has been used in constructing culverts along the railroad north of DuQuoin. At some points this rock makes a very good quick-lime, as at Mr. ARCHIE WILSON'S, five miles south-west of DuQuoin. The arenaceous limestone, which outcrops in the north-east part of the county, seems to be suitable for rough walls, and will supply the local demand in the vicinity of its outcrop. The sandstones are usually rather thin-bedded where we have seen them exposed in this county, and are too soft to be safely used in the construction of costly buildings; but they are easily dressed, and answer for light walls, flagging, etc. The sandstones outcrop most abundantly on the Little Muddy, in the north-eastern part of the county.

*Sand* and *Clay*, for bricks, may be found at almost any place where it may be desirable to manufacture them; and, from the abundance of coal, and the economy with which they can be burned, brick will always be one of the cheapest and most easily obtained materials for building purposes in this county.

*Agricultural Resources.*—In discussing the topographical features of this county, we have already spoken of the prairie lands, the post-oak flats, and the barrens, and discussed the difference in the character of the soils to which these peculiar features of the surface may be attributed; and but little remains now to be said on this subject.

The bottom lands in this county are restricted to some narrow belts along some of the principal streams. On the Beaucoup, they sometimes reach a mile or more in width, though usually they are narrower. The prevailing timber on this stream is the white-oak, swamp white-oak, bur-oak, laurel-oak, chestnut-oak, red-oak, sycamore, black-walnut, sweet-gum, scaly-bark-hickory, etc. In the breaks and bluffs of the creek, the white-oak, a tree otherwise not common in this country, is quite abundant, especially south of Pinckneyville; and these white-oak lands are reckoned among the most fertile lands in the county. The soil on these bottom lands resembles somewhat that of the post-oak flats. The sub-soil is a nearly white sand, with a small admixture of clay, and some ferruginous nodules; and the soil is composed of the same materials, with the addition of more vegetable matter, or humus. Although this post-oak soil at first seems rather poor, it would probably improve rapidly under a judicious system of cultivation, its seeming deficiencies being due to its physical constitution, rather than to a lack of any of the elements to form a good soil.

The bottoms on Columbo and Swanwick creeks are similar to those of the Beaucoup, and are covered with a similar growth of timber. On Reese's creek, the bottoms are quite narrow in the south part of township 5, where the limestones outcrop, and are scarcely wider above; but in the vicinity of DuQuoin they widen to about three-quarters of a mile. The principal growth of timber is the swamp-white-oak, scaly-bark-hickory, black walnut, ash, over-cup-oak, with an abundant growth of hazel as underbrush, which indicates a soil of good quality, and sufficiently dry for cultivation. Some miles lower down, the creek enters the bottoms of the Little Muddy, which are here two miles or more in width, and are heavily timbered with a growth similar to that on Reese's creek. At the crossing of the road, east of Old DuQuoin, the bottoms of Little Muddy are about a mile wide, and are covered with a splendid growth of swamp-white-oak, over-cup-oak, scaly-bark-hickory, red-oak, ash, and some water-oak, with but little hazel or other under-brush. At Kirkpatrick's bridge, on section 18, the bottom is about a mile wide, and averages this width as far north as the north line of township 6, and from this point gradually grows narrower to the north line of the county. A portion of these bottom lands are now too low and wet for cultivation; but they are valuable for timber, and will eventually become dry enough for farming purposes.

The character of the soils on the different varieties of upland in this county has already been briefly discussed; and but little remains to be said on this point. The soils and sub-soils consist mainly of an exceedingly fine sandy material, mixed with a smaller portion of clay; and its stiff clayey appearance is more properly due to the fineness of the material than to the proportion of clay it contains. This peculiar character renders it close and compact, and hard to drain, and not easily worked, except when quite dry. Deep plowing or subsoiling, and a liberal use of manures from the farm-yard, will rapidly improve the quality and texture of this soil, rendering it more porus, so that the water falling upon the surface will not be retained there, but allowed to pass freely through the soil into the earth below. When manures are not obtainable at a small cost, the same end may be attained by plowing under the green crops.

The *post-oak flats* were entirely neglected by the early settlers, and the land regarded as unfit for cultivation; but they are now gradually being improved, and, if judiciously treated, will eventually become productive. The growth of post-oak timber by no means indicates a poor soil; and the arboreal vegetation of these flats is probably due to the mechanical condition, rather than the chemical composition of the soil.

The prairies generally have a good soil, and produce annually large crops of cereals of various kinds; and yet the main difference between the soil of the prairie and that of the adjoining flats consists in the larger amount of humus or vegetable matter which the former contains, derived from the long continued growth and yearly decay of the grasses which every where cover the surface o the prairies. These annual crops of grass have added to the soil a large per cent. of organic matter, though far less than they would have done if, instead of being permitted to decay upon the surface, they had been turned under by the plow.

The *blue mud*, which has already been alluded to in treating on the Drift deposits of this county, may prove to be a valuable manure, especially for the post-oak flats. It appears to be composed mainly of leaves and partially decayed wood, with an admixture of clay, such as we often find accumulating in swamps or sloughs, and must contain, in a concentrated form, the organic elements, the humus, alkaline and other salts, which are the most valuable constituents of manures. It occurs at many localities in the county in great abundance, the deposit sometimes attaining a thickness of from five to ten feet; and, indeed, at one locality on the west side of Six-Mile prairie, at Mr. ANDREW BROWN'S, it was said to have been penetrated to the depth of sixteen feet without reaching the bottom. If this substance should prove to be as valuable as its appearance would indicate, it will add greatly to the productive capacities of the soils of this county, and, instead of being regarded as a nuisance, as it ha hitherto been, will be eagerly sought after by the farmer and liberally applied to his partially worn out lands. An experiment could easily be made by any farmer living near a known outcrop of this material and the application of a few loads to the poorest soil on the farm would in a year or two determine its value as a manure. Although it is generally found at a considerable depth below the surface level, it will most probably be found outcropping on some of the streams, and may thus be obtained with but little labor. Where it has been found in digging wells, it occurs from fifteen to twenty-five feet below the surface.

# CHAPTER VI.

## JERSEY COUNTY.

This county lies upon the western borders of the State, at the junction of the Illinois river and the Mississippi, and includes an area of about ten townships, or three hundred and sixty square miles. It is bounded on the north by Greene county, on the east by Macoupin and Madison counties, and on the south and west by Madison county and the two rivers above named. The central and eastern portions are mostly prairie, and are comparatively level or gently rolling; while the western portion becomes more broken as we approach the river bluffs, which are intersected by deep ravines, separated by narrow ridges, many of which are from one hundred and fifty to two hundred feet in hight. This portion of the county is heavily timbered.

The county is well watered by Macoupin creek and its tributaries, on its northern boundary, and by Otter creek and the Pisa and their affluents, which intersect the southern and western portions of the county.

The geological structure of the county presents an interesting and varied field for investigation; and the outcrops of the stratified rocks include a thickness of about one thousand feet of strata, ranging from the Lower Coal Measures to the Trenton limestone of the Lower Silurian period inclusive. In addition to the stratified rocks, and overlying them, we find the usual Quaternary deposits, reaching an aggregate of a hundred feet or more in thickness, and consisting of Alluvium, Loess and Drift. These deposits attain their greatest development in the vicinity of the river bluffs, and thin out to an average of not more than thirty or forty feet, after the general level of the high land is attained, where the Loess disappears, and only the lower division of the series, the Drift, remains.

The elevation of the Devonian and Silurian rocks to the surface in this county is due to the influence of the *Cap au Gres* axis, which crosses the Illinois river about five miles above its mouth, producing a dislocation of the strata, and forming a double tier of bluffs, which are separated by a narrow valley, from the point where this axis first makes its appearance on the eastern side of the Illinois river, down nearly to Mason's Landing, the beds on the opposite sides of this valley dipping in opposite directions; while those on the west side of this axis have been thrown down, so as to produce a decided fault in the stratification.

The following section will show the order of super-position and comparative thickness of the different groups of rocks occurring in this county:

| | | |
|---|---|---|
| | 100 feet. | Quaternary. |
| Coal Measures. | 200 feet. | Lower Coal Measures. |
| Lower Carboniferous. | 6 feet. | Chester Limestone? |
| | 60 to 70 feet. | St. Louis Limestone. |
| | 150 feet. | Keokuk Limestone. |
| | 200 feet. | Burlington Limestone. |
| | 80 to 100 feet. | Kinderhook Group. |
| Devonian. | 30 feet. | Black Slate. |
| | 10 to 15 feet. | Hamilton Limestone. |
| Upper Silurian. | 120 feet. | Niagara Limestone. |
| Lower Silurian. | 40 to 50 feet. | Cincinnati Group. |
| | 40 feet. | Trenton Limestone. |

We shall briefly describe the strata represented in the foregoing section, taking them up in their order of sequence, beginning at the top of the series:

In the *Quaternary* system, we include the Alluvium, Loess and Drift, comprising all the loose, superficial material that overlies the stratified rocks. The principal *alluvial* deposits of this county are the bottom lands bordering on the Illinois river, which form a belt on the eastern bank of that stream, with an average width of about one and a half to two miles. The soil on this bottom land is a deep sandy loam, formed mainly by the wash from the high lands of the adjacent bluffs, and the sediment deposited by the river, which submerges the lower portion of it during its annual overflows. It is exceedingly fertile, producing annually large crops of corn, wheat, oats, barley and potatoes, which are often grown year after year on the same ground, without manure, and with no perceptible diminution in the value of the crops. The surface of these lands is gradually being elevated from year to year by the causes already alluded to; the swampy portions are filling up, and the arable area is thus constantly increasing.

When the country was first settled, these bottoms produced annual crops of most luxuriant grasses, growing oftentimes, in wet portions, to a hight of six or eight feet, and the annual decay of so great an amount of vegetable matter upon the surface produced a malarious atmosphere that was quite deleterious to the health of the early settlers upon these lands. But, when the soil was once broken and the ground brought under cultivation over a considerable portion of the surface, and the luxuriant growth of vegetation on other portions was consumed by the herds of cattle that were allowed to graze upon it, the general health of the settlers improved from year to year, until at the present time these bottom lands are considered to be quite as healthy as those upon the prairies, and more so than the timbered lands of the adjacent bluffs.

The river bluffs, both on the Illinois and Mississippi, are covered with a heavy deposit of *Loess*, varying from twenty to sixty feet in thickness It presents its usual characteristic features in this county, and is composed of buff-colored marly sands and clays, sometimes partially stratified, and usually filled with shells of the common fresh-water and land varieties. It does not appear to extend very far back from the river; and its deposition is restricted to the slope between the general level of the prairie region and the bluffs bordering the river bottoms, while it appears to thin out rapidly as we recede from the river bluffs toward the higher portions of the adjacent country. It is also found filling some of the valleys of the smaller streams, for several miles back from the river bluffs, showing that these valleys were excavated by other agencies than the streams which now run in them, and at a period anterior to the existence of our present water-courses. At Thos. K. Phipps' place, on the highlands, between Otter and Coon creeks, heavy beds of Loess and Modified Drift are found filling the lateral valleys leading to these streams, and also covering the slopes of the hills so that the underlying rocks are but rarely seen. These deposits are from sixty to a hundred feet in thickness; and the Modified Drift contains bands of sandstone and Conglomerate. The sands are somewhat micaceous; and the particles of mica have excited expectations that these beds would afford valuable deposits of the precious metals. For a more minute description of the Loess formation, the reader is referred to a previous chapter* on the general geology of the State.

The Drift deposits of this county do not present any peculiar features, so far as we were able to discover. One of the most satisfactory natural sections observed in the county, was found on Otter creek, on the lands of Mr. McAdams, where the beds had been cut through by the waters of the creek. The exposure at this locality exhibited about twenty feet of yellowish-brown clay at the top, below which was seen from twenty to thirty feet of sand and gravel, with boulders; and this was underlaid by about fifteen feet of blue plastic clay, extending below the bed of the creek. Boulders of granite, sienite, green stone, quartz-rock and porphyry, are often met with in the beds of the small streams, and have been washed out of the gravel bed, which forms the middle division of the drift in this vicinity. This gravel bed furnishes the main supply of water for the wells in this county; and the upper clay bed affords an inexhaustible supply of clay suitable for the manufacture of brick. About two miles south-east of Fieldon, on a small branch of Otter creek, a pottery has been established, and is supplied with clays from the Drift, by using a mixture of the blue plastic clay with the brown clay above. It makes a rather coarse and inferior quality of ware, by no means equal to that made from the argillaceous shales of the lower Coal Measures. But it seems quite probable that, by thoroughly washing the blue clay before mixing, it may be made to answer a valuable purpose for the manufacture of the coarser varieties of ware, such as drain-tile and the earthen cylinders used in sewers; and, as the supply of these clays, from the thickness of the beds, may be considered as unlimited, the question of its adaptability to such purposes should be thoroughly tested. Fragments of wood, and even trees of considerable size, are often met with in sinking wells or in making other excavations in the plastic clay.

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* Volume I, chapter ii, pp. 33, 38.

## *Coal Measures.*

The rocks in this county that may properly be referred to the *Coal Measures*, include a thickness of about one hundred and fifty to two hundred feet, embracing three or more seams of workable thickness. These coal-beds underlie the eastern portion of the county, and outcrop on the Piasa at all points north and east of the Jerseyville and Alton road, as well as on the southern affluents of the Macoupin. On the extreme western confines of the coal region, the measures are thin, and are sometimes composed entirely of sandstones and shales, with no coal of any value; but as we proceed eastwardly, toward the center of the coal-field, the measures increase in thickness, and the seams of coal become more numerous. The following section, compiled from the various local sections we were able to see, may be taken as the approximate thickness of the measures in this county:

| | | |
|---|---|---|
| Gray shale, partially exposed west of Brighton | 10 | feet. |
| Compact brownish-gray *Fusulina* limestone | 6 | " |
| Brown calcareous shale | 3 | " |
| Green and blue argillaceous shales | 8 to 10 | " |
| Coal, No. 6 | 2½ to 3 | " |
| Shaly clay | 1½ | " |
| Calcareous shale, with bands of limestone and septaria | 6 | " |
| Clay shale | 8 to 10 | " |
| Limestone and bituminous shale | 3 | " |
| Coal, "Howlett seam," No. 5 | 3 to 4 | " |
| Shaly fire-clay | 1 to 2 | " |
| Nodular argillaceous limestone | 4 | " |
| Gray shales | 30 | " |
| Bituminous shale, sometimes overlaid with limestone, probably representing the horizon of coal No. 3 | 3 to 4 | " |
| Sandstone and shale | 40 to 50 | " |

| | |
|---|---|
| Coal, No. 1 ? | 2 to 3 feet. |
| Clay shale | 2 " |
| Nodular, dark-blue, compact limestone, in local outcrops | 3 to 5 " |
| Shale and sandstone | 10 to 20 " |

The upper beds in this section, including the two upper coal-seams, were only seen exposed together at one locality in the vicinity of Brighton, in the south-east corner of the county, on the head-waters of the Piasa, and about one mile west of the town. The upper limestone in the section above is a gray, compact stone, weathering to a rusty-brown color, and sometimes occurs in massive strata, from two feet to two and a half in thickness, with its surface thickly covered with *Fusulina.* It also contains plates and spines of *Echino-cidaris, Athyris subtilita* and *Spirifer lineatus.* From the calcareous shale below the limestone, we obtained very large joints of crinoidea, *Productus semereticulatus, P. longispinus, Spirifer lineatus, S. Kentuckensis, Retzia punctulifera, Chonetes mesoloba, C. granulifera,* an undertermined *Platyceras,* etc.

The upper seam at this locality, which we refer without hesitation to the horizon of coal No. 6, of the general section, has been opened here by drifting into the hillside along the line of outcrop, and has also been passed through in the shafts which have been sunk in this vicinity down to the lower or No. 5 coal. It is somewhat thinner here than the lower seam, and has a roof of clay shale that requires thorough cribbing to enable the miners to work the coal with safety; and for these reasons they prefer to work the lower seam, which has a better roof, and is also somewhat thicker than the one above it. These coals are separated here by from twenty to thirty feet of shaly strata, and are both underlaid by a calcareous clay shale, passing into hard argillaceous limestones, which are generally concretionary, and sometimes appear as nodules of limestone embedded in the shale.

The lower seam is overlaid by a brown argillaceous limestone, which sometimes comes immediately above the coal, or is separated from it by a thin bed of bituminous shale. At the openings near Brighton, the seam ranges from three feet to three feet nine inches in thickness, and affords a coal of fair quality, but containing more sulphuret of iron than the coal from the upper seam, which is here considered the best smiths' coal.

At SAMUEL AUSTIN'S place, on the south-east quarter of section 10, township 7, range 10, this seam has also been opened; and the coal from this mine is said to be the best yet found in the county. It ranges from three and a half to four feet in thickness, with a good slate and limestone roof, and is said to afford a good coking coal.

At ANDREW WILLIAMSON'S place, on section 16, in the same township, the coal has about the same average thickness; and the exposure here afforded the following section from the creek to the coal:

| | |
|---|---|
| Limestone, compact and brownish-gray | 4 feet. |
| Coal, No. 5 | 3½ to 4 " |
| Shaly fire clay | 4 to 6 " |

| | |
|---|---|
| Gray nodular limestone | 4 feet. |
| Shale, partially exposed | 25 " |
| Bituminous shale, (coal No. 3 ?) | 2 to 4 " |
| Shale, partly exposed down to the creek level | 22 " |

This seam has also been opened on the south-west quarter of section 10, township 7, range 10, where it is about five feet thick, and was worked by Mr. Langley, in 1854, at the time of our first visit to this county. The coal afforded by this seam varies considerably at the different mines where it has been worked. At some localities, it contains considerable sulphuret of iron, and can not be used for blacksmithing; at others, it is quite free from it, and becomes a good smiths' coal. It everywhere contains carbonate of lime, in thin white plates, traversing the cleavage joints of the coal; and at some localities the sulphate of lime, or selenite, in thin crystalizations, is found in it; but these calcareous minerals do not affect the quality of the coal injuriously, like the combinations of sulphur and iron.

This seam, from the localities above cited, affords nearly all the coal at present mined in this county. It will probably be found to underlie the greater part of townships 7 and 8, in range 10. The strata appear to lie very nearly horizontal; though at the Langley mine the coal dipped to the north-east sufficiently to drain the mine through the adit which enters the hill in a south-westerly direction. This is probably the general direction of the dip in this vicinity.

The lower seam, which is exposed on the Piasa, east of Delhi, has been opened at various localities along the bluffs of the creek, within a distance of two miles from the town. The coal varies in thickness from two to three feet, and is overlaid by a few inches of bituminous shale, which passes upward into a brown or chocolate-colored clay shale. It is underlaid by fire-clay, the thickness of which was not determined, and about ten feet of sandy shale and sandstone, which rest directly upon the St. Louis limestone. About half a mile west of Langley's mine, a dark bluish-gray concretionary limestone is seen in the bed of the creek, from three to four feet in thickness, which is overlaid by ten or twelve feet of gray shale. This limestone closely resembles that usually underlying the Exeter coal-seam in Greene and Scott counties; but, if it is the same, the coal is wanting here. We also saw a similar limestone a half mile north of Delhi, in a small ravine on the west side of the Jerseyville road; but no coal-seam appeared to be associated with it here. If this is the limestone usually associated with the No. 1 or Exeter coal, then the seam which has been opened on the Piasa, near Delhi, and underlies this limestone, would be the Conglomerate coal, and the equivalent of a thin coal found below Moore's coal, on the Little Sandy, in Scott county, in a similar position, for a description of which, see the report on that county in a following chapter. The coal which this seam affords is much inferior in quality to that obtained from the higher seams, and consequently it is not much worked at the present time. Coals Nos. 2, 3 and 4, of the general section, do not appear to be developed at all in this county.

The western boundary of the coal-field, in that part of the county lying north of Jerseyville, is not well defined, in consequence of the scarcity of any rock exposures below the Drift. In sinking a well at the steam mill in Jerseyville, a few feet of soft micaceous sandstone were passed through, which no doubt belong to the Coal Measures. From Jerseyville the general trend of the western borders of the Coal Measures is to the north-east; and, on Phill's creek, at J. FINK'S place, on section 29, township 9, range 10, a thin-bedded micaceous sandstone is exposed, about six feet in thickness, and extending below the creek level. Some of the layers are finely ripple-marked; and the rock, when of the proper thickness, makes a good flagging stone. The streams in the north-east part of the county run through broad valleys, filled with Drift to such a depth that the stratified rocks are rarely exposed; and consequently it is impossible, without artificial excavations, to determine the precise line of boundary between the different formations. The sandstone on Phill's creek is no doubt a Coal Measure deposit, and probably the same as that penetrated at the mill in Jerseyville. It probably represents the sandstone lying near the base of the Coal Measures. Two miles nearly due north of Jerseyville, in the bed of a creek, a chert bed is exposed on the south-west quarter of section 4, which no doubt belongs to the limestones below the Coal Measures.

Passing below the Coal Measures, we come directly upon the Lower Carboniferous limestone series, the different members of which form a broad limestone belt that extends from the western borders of the Coal Measures to the river bluffs. The limestone formation is mainly represented by the St. Louis limestone mentioned in the general section; but, at two or three points in the county, we saw some beds of arenaceous material, lying between the Coal Measures and St. Louis limestone, that appeared like thin outliers of the Chester group. On the south-west slope of Beatty's Mound, in a little run which empties into Otter creek, we found a stratum of white sandstone or arenaceous limestone about one foot in thickness, containing *Retzia vera*, *Athyris ambigua*, and an undetermined shell like a *Modiola*; and below this stratum a few feet of thin bedded sandstone were seen, which rest upon the St. Louis limestone. At Clapper's quarries, about three miles south-west of Jerseyville, the St. Louis limestone is overlaid by similar beds, consisting of about four feet of brown ferruginous sandstone, and about two feet of light-gray calcareous sandstone, very much like that at Beatty's Mound, except that it contained no fossils, so far as we observed, at this locality, and was associated with some thin beds of chert. Nodules of a fine iron ore were found here in the shaly portions of the brown sandstone, underlying the light-gray rock. The lithological character of these beds, and their stratigraphical position, would tend to confirm the conclusion that they are the attenuated representatives of the beds above named, even in the entire absence of characteristic fossils. In Randolph county, this group has an aggregate thickness of more than six hundred feet; but it thins out rapidly toward the north, and, in the bluffs at Alton, we recognize it with an aggregate thickness of only about fifteen feet. In Jersey county, the beds representing this group are only from six to seven feet thick; and north of this county, they have not yet been recognized at all: if they were deposited at points further north, the strata have been worn away by the denuding forces which seem to have been in active operation at the commencement of or anterior to the coal-bearing period.

*St. Louis Limestone.*—This formation appears to be considerably thinner in this county than in Madison, and also changes somewhat in its lithological characters, on the north side of the Piasa. No single section was seen in this county that exhibited a greater thickness than about seventy-five feet of this limestone; and its maximum thickness in the county probably does not exceed one hundred and twenty feet. About one mile above the Piasa, the upper portion of the river bluff consists of about seventy-five feet of strata that may be referred to this formation, consisting of buff and brown magnesian limestones. The upper half of the bed is here a thin-bedded, buff-colored limestone, that becomes shaly on exposure to the atmosphere; while the beds below are tolerably massive, affording layers from one to two feet in thickness. These lower beds contain *Spirifer lateralis*, *S. Keokuk*, *Orthis dubia* and a *Syringopora* of undetermined species. Below these massive beds, we find about six feet of earthy, ash-colored, hydraulic limestone, the same, probably, that is quarried at the cement mill on the Piasa. Under the hydraulic limestone, there is a covered slope of sixty feet in which the strata are not exposed; and below this slope there is an exposure of one hundred and twenty feet of Keokuk limestone, extending to the river level. The beds forming the upper portion of the bluff at this point present the same general characters observed a short distance west of Delhi, where this limestone is immediately overlaid by the Coal Measures; and the heavy beds of evenly-stratified and concretionary gray limestone, which form the upper division of this formation at Alton and St. Louis, are scarcely represented at all in this county.

At the hydraulic mill owned by the heirs of the late ROBT. G. SMITH, Esq., on the north side of the Piasa, the hydraulic limestone is eight feet in thickness, and is underlaid by about thirty feet of shaly magnesian limestone, extending down to the level of the creek. Overlying the hydraulic limestone at this locality, are beds of brown magnesian limestone, similar in character to that just described as overlying the hydraulic limestone in the section at the river bluff, and containing the same fossils, with some additional species, such as *Rhynchonella subcuneata* and *Palæacis cuneatum*.

On the Piasa, two miles south-west of Delhi, a series of brown and gray limestones are exposed in alternating beds, which attain a thickness altogether of about forty feet. Some of the brown beds are quite soft, and weather to a brown calcareous shale. The gray beds are compact and massive, and afford a good building stone. The abutments for the railroad bridge on the Piasa are built from the gray beds which outcrop in this vicinity. The strata at this locality afford the same fossils already named as characteristic of these limestones at other localities in this county; and I also saw in the cabinet of Dr. Farley, of Jerseyville, a specimen of *Melonites multipora*, which he informed me was obtained at the quarries two miles west of Delhi, associated with *Rynchonella perrostrata*, and the species above named.

Cooper's quarries, on a branch of Otter creek, about three miles south-west of Jerseyville, are in this formation; and the rock at this locality presents the same general characters as at the other localities already mentioned.

This group thins out toward the north; and, although no satisfactory exposure of the bed was seen north-west of Jerseyville, we will hazard the opinion that it no where exceeds a thickness of forty or fifty feet in the northern part of this county.

About five miles above Mason's landing, the St. Louis limestone is found, forming a part of the river bluff, where it has been thrown down by the dislocation of the strata at the point where the Cap au Gres axis crosses the river. The beds exposed here present the same lithological characters as at Alton, and the rock is quarried and burned for lime. The beds here dip nearly south, at an angle of about twenty-five degrees. There are from forty to fifty feet in thickness of these gray limestones exposed here; but the strong dip soon carries them below the surface, and the extent of the outcrop is quite limited.

*Keokuk Limestone.*—This formation, which underlies the St. Louis limestone, has a maximum thickness in this county of about one hundred and fifty feet. In the bluffs of the Mississippi, between Jersey Landing and the Piasa, it is well exposed, and forms the upper part of the bluff, a half mile below the first named point; but a gentle dip down the river, or in an easterly direction, soon brings it down to the river level; and, about a mile and a half above the mouth of the Piasa, it forms only the lower portion of the bluff, while the upper part is formed by the St. Louis limestone, as described in a foregoing section. The upper part of the formation is hidden at this locality by a covered slope about sixty feet in thickness; but, on the branches of Otter creek, it is found to consist of blue and buff-colored calcareo-argillaceous shales, such as usually characterize that portion of the formation known as the *geode bed;* and it is here, as elsewhere, filled with silicious geodes, containing crystals of calcite, quartz and the common botryoidal forms of chalcedony.

The lower part of this group, comprising about two-thirds of its aggregate thickness, may be described as a thin-bedded, cherty, bluish-gray crinoidal limestone, with partings of blue or yellow marly clay between the beds. It is well exposed on the forks of Otter creek, between Grafton and Jerseyville; and sections of the strata from twenty to forty feet thick may be frequently seen along the bluffs of these streams. It is generally thin-bedded, seldom affording strata more than a foot in thickness; and these are usually separated by thin seams of marly clay. On the surface of the limestone layers, when the clay has been removed by weathering, the characteristic fossils of this formation may be obtained in a fine state of preservation. Very fine specimens of *Archimedes* of an undetermined species have been found here; also *Oligoporus Danæ*, *Agaricocrinus Americanus*, *A. Wortheni*, *A. Whitfieldi*, *Actinocrinus Nashvillæ*, *A. Mississippiensis*, *Productus punctatus*, *P. semireticulatus*, *Athyris incrassata* and *Zaphrentis Dalii*, which are the most common fossils afforded by these limestones on Otter creek. North-west of Jerseyville, where this limestone undoubtedly forms the fundamental rock on which the Quaternary deposits rest, no considerable exposures of it were found, for the reason that there are no streams on the south side of the Macoupin, and west of Phill's creek, of sufficient size to cut through the superficial deposits and expose the rocks below.

*Burlington Limestone.*—This important subdivision of the Lower Carboniferous limestone series is well developed in this county, with an aggregate thickness of about two hundred feet, and underlies a belt of country several miles in width along the river bluffs, throughout nearly the whole extent of the county from north-west to south-east, until it finally passes below the river level a short distance below Jersey Landing. Immediately below Jersey Landing, the bluff is composed entirely of this limestone, and is one hundred and ninety feet in hight above the river. It consists of alternate layers of light-gray and brown limestone, with a considerable amount of cherty material disseminated through it in seams and nodules. About midway of the mass, at this locality, there is a bed of yellow, partly decomposed chert, from fifteen to twenty feet in thickness; and above this the limestone becomes more thin-bedded and cherty than it is below. The lower part of the formation is a regularly-bedded light-gray limestone, the strata ranging from six inches to two feet in thickness, and appearing to be composed almost entirely of the plates and joints of crinoids, forming what is termed a *crinoidal* or *encrinital limestone*. The remains of crinoids in a good state of preservation, however, are extremely rare in this formation at every locality we were enabled to examine in Jersey county; and in this respect it presents a marked contrast to the outcrops of this limestone at more northern localities. The principal fossils which it affords in Jersey county are *Euomphalus latus*, *Productus semireticulatus*, *Spirifer plenus*, *S. Grimesi*, *S. striatus*, *Orthis Michelini*, *Athyris lamellosa*, and *Chonetes Illinoisensis*.

The limestone bluffs in the vicinity of Jersey Landing are exceedingly bold and picturesque. They are capped by heavy beds of Loess, which makes the entire elevation from two hundred and twenty-five to two hundred and fifty feet in hight, with a precipitous limestone cliff from one hundred and fifty to two hundred feet high. At the time of our last visit to this locality (in May, 1864), a pair of eagles, guided by that instinct that leads them to select the most inaccessible location for their breeding places, had built their nest upon a projecting shelf of limestone, about thirty feet below the summit of the perpendicular limestone cliff, about half a mile above the village. Below them was a mural wall of limestone nearly one hundred and fifty feet high, and from above they could only be reached by a rope let down—a feat which but few would be bold enough to undertake. While we were prosecuting our examinations at the foot of the bluff, the male bird sat perched upon a tree at the summit of the cliff, keeping a vigilant watch while his mate occupied the nest below. The accompanying view, (plate F), is given to illustrate the scenery produced by this limestone, where it forms the bluffs of the Mississippi. It is a view of the prominent bluff, known as Mount Vernon, just below Jersey landing, where the perpendicular cliff, nearly two hundred feet high, is composed almost entirely of Burlington limestone.

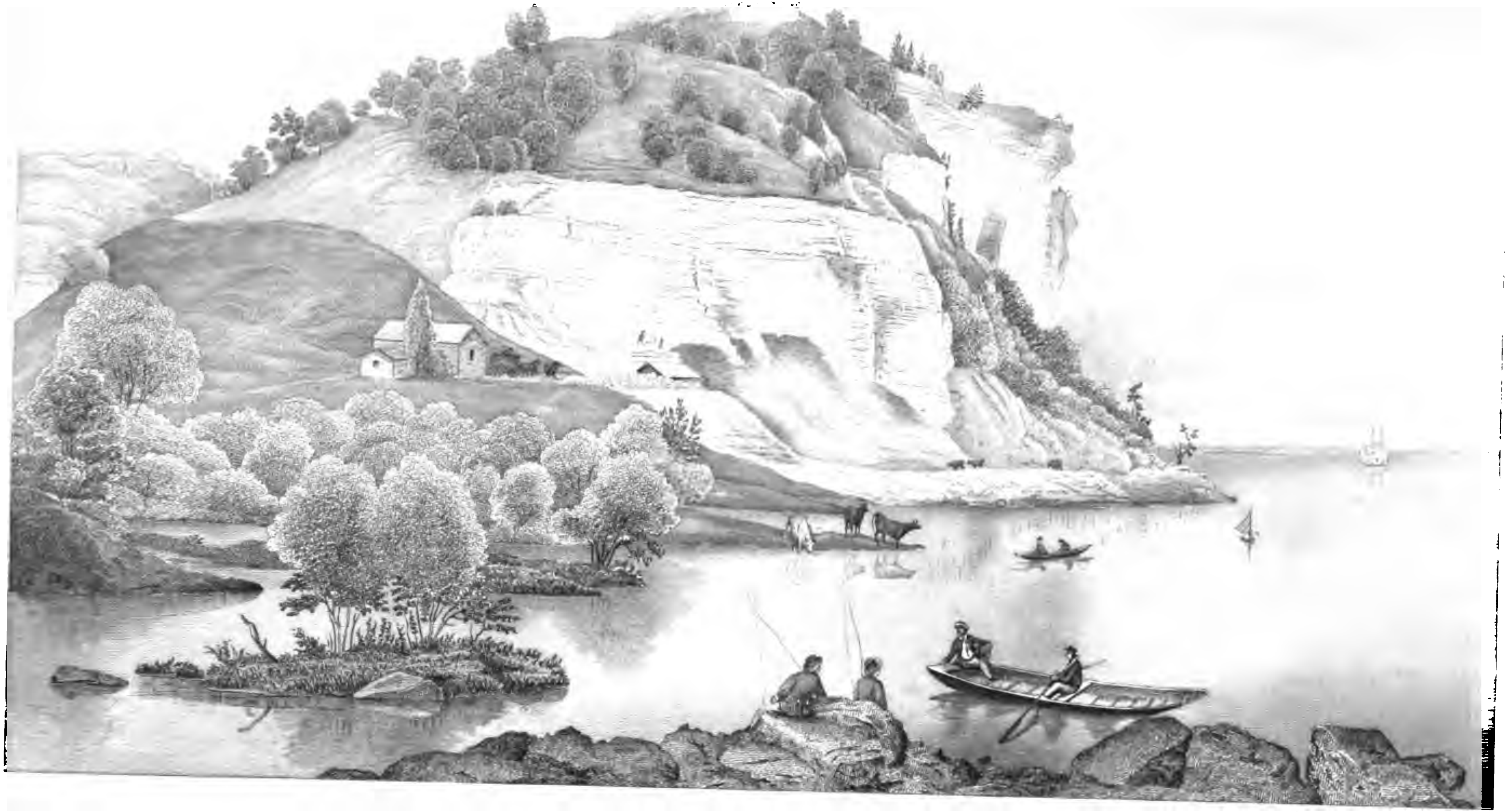
The view from the summit of these bluffs is very fine, and will well repay the labor of climbing to the top. To the south, the turbid Missouri, and the rich fertile valley which separates the two great rivers at this point, can be seen for many miles in extent from east to west; while the broad reaches of the Mississippi, which here runs nearly due east, form a magnificent foreground to the picture.

From Otter creek to the Macoupin, the bluffs are formed mainly of this limestone, with an occasional outcrop of the Kinderhook group at the base; and in the vicinity of Fieldon it outcrops on all the smaller streams.

At THEODORE LANCE's lime-kiln, on Borer creek, this limestone forms perpendicular bluffs from forty to fifty feet in hight. The rock here presents its usual characters of a light-gray crinoidal limestone, with cherty seams and nodules, and is quarried for lime-burning. A bed of chert four or five feet in thickness forms the top of the exposure at this point. The quarries at this locality afford the same fossils already mentioned as occurring near Jersey landing. Near the mouth of Sugar creek, a hundred feet or more in thickness of this limestone may be seen at a single exposure.

At the farm of Mr. JAMES REDDISH, on the south-west quarter of section 4, township 8, range 13, this limestone, with the upper part of the Kinderhook group, forms a nearly perpendicular bluff more than a hundred feet high. The rock forming the upper part of this exposure is a massive gray limestone, with a few seams of chert. *Strophomena analoga*, *Spirifer Grimesi* and *Euomphalus latus* were obtained here. This rock is frequently intersected by fissures, which sometimes lead into caverns of considerable extent, and also afford an outlet to subterranean streams of water, which gush from the base of these bluffs in perennial springs.

In the vicinity of Mason's Landing, this limestone forms the upper bench in the high bluffs back of that point; and the beds of the small streams are filled with fragments of chert, derived from this formation by the decomposition of the calcareous portions of the mass. These cherty masses often afford delicate



[illegible] Limestone.

MOUNT VERNON BLUFF, JERSEY CO.

[illegible]

[illegible]

[illegible] *Note.*—The [illegible] that [illegible]

[illegible]

[illegible] is the [illegible]

[illegible] mining [illegible]

[illegible] exposed [illegible]

[illegible] the coast. The [illegible]

[illegible] of the D[illegible] and S[illegible]

[illegible] The Coal M[illegible]

[illegible]

and beautiful casts of the crinoids and other characteristic fossils of this formation.

*Kinderhook Group.*—This group forms the base of the Lower Carboniferous limestone series in this portion of the State, and rests directly upon the Devonian shales. In this county, it consists of thin-bedded, ash-colored, impure earthy limestone, with some massive layers of dolomitic limestone in regular beds. The shaly portions contain nodules of calcite, resembling geodes, which are coated with a very thin outer crust of chalcedony. About four miles below Grafton, this group measures about a hundred feet in thickness. The lower part consists of thin beds of impure cherty limestone, of a brownish-gray color, which contain the nodules of calcite above mentioned; and this is overlaid by a regularly-bedded brown dolomitic rock, from fifteen to twenty feet in thickness; and this is again overlaid by ash-colored cherty beds, which pass upward into the overlying Burlington limestone, with no well-defined line of demarcation between them. The arenaceous beds, so characteristic of this group at the typical locality, as well as at other more northerly points, are here replaced by calcareous strata. A few fossils were obtained from this group in the vicinity of Grafton, among which were *Spirifer Vernonense*, *Athyris Prouti*, *Strophomena analoga*, *Productus semireticulatus*, and several species not yet determined. The outcrop of this formation is confined to the vicinity of the river bluffs; and from Otter creek to the Macoupin there is a continuous exposure of this group at the base of the bluffs, wherever the beds are not covered by a talus from the overlying limestone.

*Black Slate.*—The slates and shales that form the upper division of the Devonian system in the west, to which the above name is usually applied, have not been largely developed in this portion of the State; but the formation is represented in this county by from twenty to thirty feet of green shale, including, at some localities, a bed of black, bituminous shale or slate, from which fact it is often supposed to contain coal; and much labor has been expended in the search for it at several points in the county. These explorations have frequently been undertaken by the advice of those professedly acquainted with coal mining, who, having learned, in the prosecution of their labors as coal miners, that black slates are usually associated with the coal seams, are nevertheless quite ignorant of another and equally important fact, that bituminous slates are not always associated with bituminous coal, and sometimes do not even belong to the Carboniferous system, as is the case with the slate now under consideration. Hence, these slates are known in mining parlance as "coal-blossom;" and miners are always found that are ready to recommend a search for coal wherever beds of this kind appear, utterly regardless of the geological horizon to which they belong. This has resulted in the useless expenditure of more money, in nearly every county where these shales are exposed, than a complete scientific survey of the county would have cost. The bituminous slates and shales of the Devonian and Silurian system can only be distinguished from those of the Coal Measures by a careful examination of the strata associated with them, a work which ordinary coal-miners are in no way qualified to perform and hence their judgment is not to be relied on.*

The outcrop of this formation, in this county, is confined to the river bluffs between Grafton and Otter creek, extending up the valley of the last named creek for about two miles. Nodules of iron pyrites abound in the shales at some localities; but they afford no material of value for economical purposes, and in this county have thus far afforded no fossils.

*Hamilton Limestone.*—Below the black slate in this county, and resting upon the Niagara limestone, we find a thin bed of earthy, brown limestone, from eight to fifteen feet in thickness. The rock appears quite massive in newly opened quarries; but on exposure at the surface it splits into thin shelly layers, and hence will not prove to be a reliable building stone. At some localities the bed has somewhat the appearance of a hydraulic limestone; but its value in this respect has not been thoroughly tested.† It is well exposed in the town of Grafton, where, by an undulation of the dip, the bed is brought down to the level of the town, though occupying a much higher position both above and below. We found in the beds at this locality *Strophomena fragilis*, *Atrypa reticularis*, and joints of *crinoidea*, with some *fish remains*. A thin layer of shaly limestone, at the junction of this bed with the Niagara limestone, is filled with silicious corals belonging to the genus *Cystiphyllum;* but their specific characters have not yet been determined. About a mile back of Mason's landing, this bed is exposed near the place where the attempt was made to find coal in the overlying shale. It is here only about eight feet in thickness, and presents the same appearance as at Grafton. Just below the mouth of Otter creek it is found exposed, forming the base of the bluff, and is here about fifteen feet in thickness. The beds at this point appear to stand exposure better than at the other localities mentioned; and they may afford some good building stone. They are here overlaid by about four feet of brittle, bluish-gray, or dove-colored limestone, that resembles in some respects the Lithographic limestone of the Missouri Report; and, if they represent that rock, the black slate must be wanting at this point.

*Niagara Limestone.*—This important division of the Upper Silurian system is well exposed in this county, forming a considerable portion of the river bluffs

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* It may be considered as still an unsettled question, whether this slate belongs most properly to the Devonian or the Lower Carboniferous system. The only fossil which it has hitherto afforded in Illinois is a *Lingula*, which, on critical examination, proves to be distinct from the *L. spatulata* of the Genesee slate; and, as the slates of this group frequently pass into the arenaceous shales of the Kinderhook group above, without any visible line of separation between them, we are inclined to doubt the propriety of considering the black slate of the west as of Devonian age. There is every where a clear and well marked line between this slate and the Hamilton beds below, far more distinct than that between the slate and the group above.

† For an analysis of this limestone, see the appendix to this volume.

[illegible]

from a point about a mile below Grafton to Otter creek, where it disappears with a north-easterly dip below the surface. It has a thickness in this county of about one hundred and twenty feet, and is a buff-colored dolomitic limestone, in regular beds, which vary in thickness from four inches to three feet. The quarries in the vicinity of Grafton present a perpendicular face of this rock, about forty feet in hight, embracing the upper part of the formation. The rock is even-textured, cuts easily when freshly quarried, but hardens on exposure, and is remarkably free from chert or other silicious material. Mr. PRATTEN's analysis of this rock gave the following result:

| | | |
|---|---|---|
| Carbonate of lime | 50.15 | |
| Carbonate of magnesia | 42.20 | |
| Peroxide of iron and alumina | 2.10 | |
| Insoluble matter | 5.15 | |
| Loss | 40 | 100.00 |

It is undoubtedly the exact equivalent of the "Joliet limestone," and in its general character and appearance corresponds very nearly with the buff-colored beds at that locality. The color of the rock is much more uniform in this county than at Joliet; and it does not present those alternations of buff and gray which characterize the different strata at more northern localities; and, as a reliable building stone, it is not surpassed by anything at present known in the Mississippi valley. Fossils are not very abundant in it; but the quarries at Grafton afford *Calymene Blumenbachii*, *Lituites Capax*, and *Orthoceras annulatum?* The outcrop of this formation is confined to the bluffs of the Illinois and the Mississippi in this county, no where appearing at the surface at any considerable distance from the rivers. Plate E is a view of Mason's Bluff, at the mouth of the Illinois river, showing an outcrop of the Niagara limestone at the base of the hill, with the Lower Carboniferous limestones above.

*Cincinnati Group.*—The Lower Silurian system is only represented in this county by the shales of the Cincinnati group, and about forty feet of the upper part of the Trenton limestone, which appear at only a single locality, about five miles above Mason's landing, on the north-east quarter of section 9, township 6, range 13, where the *Cap au Gres* axis crosses the Illinois river. Owing to the soft argillaceous character of the shales at this locality, they are no where well exposed, but are usually covered up by the debris along the base of the bluffs, exhibiting only at intervals slight exposures of a light-gray, shaly clay, somewhat resembling the fire-clays of the Coal Measures. Their outcrop extends from the point above named to within about a mile of Coon creek, where they dip below the surface. This group contains some plates of dark-brown sandstone, and nodules of iron pyrites. Its thickness we were not able to determine accurately by measurement, but have estimated it approximately at from forty to fifty feet. No fossils were found in it in this county; and no indications were seen of the presence of the bituminous shales and slates which are characteristic of it at more northern localities. It appeared to be mainly a light, bluish-gray clay shale, that weathered on exposure to a pure clay, apparently suitable for a potter's clay.

*Trenton Limestone.*—This formation only appears above the surface at one point, which is on the north-east quarter of section 9, township 6, range 13, where about forty feet of the upper part of it is exposed. The rock is thin-bedded, compact, and of a light-gray color, splitting easily with an uneven cleavage. The rock has been quarried here, at Williams' lime-kiln, for lime-burning, for which it is tolerably well adapted, though by no means equal to the St. Louis limestone, which is quarried for the same purpose on the other side of the axis, a half mile below. This outcrop of Trenton limestone is on the northerly side of the axis, and the rocks dip to the north-east; but, immediately below, the dip is reversed, and the Niagara limestone and the whole series of Devonian and Lower Carboniferous limestones are thrown down in a distance of half a mile. The two lime-kilns, situated less than half a mile apart, are thus supplied by two distinct limestone formations, which, if remaining in their normal position, would be separated from each other by a thickness of at least eight hundred feet of strata, which here, by sudden dislocation and downthrow, are brought in close proximity to each other. This axis of disturbance gives origin to a double series of bluffs, which extend from this point nearly to Mason's Landing, with a deep valley between, with the strata on either side dipping in opposite directions. All the Silurian and Devonian strata that appear above the surface in this county have been elevated by the disturbing forces that formed the axis above described; and they soon pass below the surface, as the influence of this elevating movement diminishes in either direction.

## *Economical Geology.*

*Coal.*—Although there are three or four distinct seams of coal cropping out in this county, but one of them is mined to any considerable extent at the present time (1864). This is the No. 5 coal of the general section, and varies in thickness in this county from three to five feet. It is the equivalent of the lower seam in the old Pittsburg mines, in St. Clair county, and the lower seam on Hodges' creek, at the east line of Greene county. It affords a coal of fair quality, and is capable of yielding four million tons of coal to every section of land which it underlies. It will afford an ample supply of coal for this region for centuries to come.

The upper seam we were not able to examine in a very satisfactory manner, but were informed that it was from two and a half to three feet in thickness, where it has been opened, and afforded a coal of fair quality; but, in consequence of the shaly character of the roof, it had not been much worked, except along the outcrop of the seam, where the coal was dug in open trenches by throwing off the superincumbent clay and soil. It could be worked in the usual manner by drifting; but the entry would require thorough cribbing to support the roof. The middle or No. 5 seam has a good limestone roof, and consequently can be mined much more easily and safely than the upper seam.

Below the middle seam there are from sixty to eighty feet of shales and shaly sandstones separating it from the lower seam, which appears to be the equivalent of coal No. 1, or possibly it may be even lower, and represent a Conglomerate coal. It affords a coal of rather inferior quality, owing to the sulphuret of iron which it contains; and, since the opening of the upper seam, the lower one has been generally abandoned. These coal-seams are mainly restricted to the eastern tier of townships in this county.

*Clays.*—As has already been observed in our remarks on the Drift deposits of this county, a pottery has been established near Fieldon, the material for which is obtained from the plastic clay at the base of the Drift, which answers tolerably well for the manufacture of a coarse quality of ware. But the clays that are usually found associated with the lower coal-seams afford a much better material for the manufacture of potters' ware or fire-brick, and may yet be found in this county.

*Hydraulic Limestone.*—A bed of this useful material is found in the bluffs of the Piasa, intercalated in the lower part of the St. Louis limestone. The bed is about eight feet in thickness, and is quarried by drifting into the face of the bluff. It is about forty feet above the Piasa; and the hydraulic rock is overlaid here by heavy beds of buff-colored magnesian limestone. Below the hydraulic rock, the beds become shaly, and pass downward into the calcareo-argillaceous shales of the geode bed of the Keokuk group. Smith's cement mill, erected at this point, has capacity to grind two hundred barrels per day. This hydraulic bed also crops out in the river bluffs, above the mouth of the Piasa, and may undoubtedly be worked at several localities, should the demand for it warrant increased facilities of manufacture.

*Quick-lime.*—All the main limestone formations in the county afford more or less material adapted to the production of lime, though the best article will probably be obtained from the Carboniferous limestone. The compact bluish-gray beds of the St. Louis limestone, and the light-gray limestone of the Burlington series, afford an inexhaustible supply of the very best material for this purpose. Some of the beds of the Keokuk limestone on Otter creek may be used for this purpose, and will supply the local demand in that part of the county.

*Iron Ore.*—No indications of the existence of any extensive deposit of iron ore were observed, though there is a band of dark-red hematite occurring in the sandstone overlying the St. Louis limestone at Cooper's quarries. The ore appeared to occur only in nodules, and not in sufficient quantity to be of any value. It affords, however, some interesting specimens of this variety of ore. Although only seen at a single locality, it will no doubt be found at other points in the county occupying the same horizon.

*Building Stone.*—Of all the natural resources of this county, except coal, there is none that will eventually conduce more to its wealth and general prosperity than its unlimited supply of superior building stone. Of the five important limestone formations in this county, all afford more or less building stone of good quality; while the Niagara limestone, the most important of all, will afford an inexhaustible supply, which, in point of quality, is not excelled by anything of the kind at present known in the Mississippi valley. Its outcrop being entirely confined to the river bluffs, it can be easily transferred from the quarries to barges, on which it can be cheaply conveyed to any desired point on the Illinois or the Mississippi rivers. It is a regularly-bedded, even-textured, buff-colored dolomite, easily cut into any desirable form, and one of the most durable rocks in the State. It affords strata of every desired thickness, from four inches to three feet. The thinnest beds afford a good flagging-stone; while the thicker ones furnish dimension-stone of any desirable size. The material for the *Lindell Hotel*, in St. Louis, was obtained from the Grafton quarries, and it would hardly be an exaggeration to say that this bed of limestone, alone, will afford material enough in this county to build a continuous city from the mouth of the Illinois river to St. Louis. It is at least one hundred and twenty feet thick, and outcrops from Otter creek to a point about a mile below Grafton, where it finally dips below the river level and disappears.

The Burlington limestone, which forms the entire bluff in the vicinity of Jersey landing, also affords an excellent building stone, and has been used for the construction of mills, ware-houses and dwellings at that point. It is nearly white in color, cuts easily, and is an excellent material for caps and sills, where a light-colored rock is desired. It is not as evenly bedded as the Niagara limestone, and contains some seams and nodules of chert.

The St. Louis limestone affords an abundant supply of material for rough walls and heavy masonry, at all the localities where it outcrops in this county. On the Piasa, any where from the bridge on the Jerseyville and Alton road to the river bluffs, this limestone may be found, and will afford all the material for foundation walls and heavy masonry that may be needed for local use.

The Keokuk limestone, in its outcrop on Otter creek, will also furnish some tolerably good building stone; but it is generally unevenly bedded, and contains much cherty material.

That part of the county lying east of Jerseyville is very poorly supplied with building stone; the sandstones and thin beds of limestone belonging to the Coal Measures being the only rocks that outcrop in this part of the county. The shaly sandstones below the main coal-seams crop out on the Piasa, in the south-east part of the county, and afford some material suitable for walling wells, etc., but too soft for heavy masonry. At J. FINK'S quarries, on Phill's creek, north-east of Jerseyville, a similar sandstone is found, that answers very well for flag-stones and light walls. The brown *Fusulina* limestone, that crops out about a mile west of Brighton, is a very hard and durable rock, and will supply the local demand for culverts and foundation walls in the vicinity of its outcrop.

*Soil, Timber, etc.*—The topographical features presented by the uplands in this county are quite varied. Adjacent to the bluffs of the great rivers which form the southern and western boundaries of the county, and extending back for a distance of from three to six miles, the surface is broken into steep ridges, which are separated by deep ravines. The soil is a dark-colored loamy clay, such as is every where characteristic of lands underlaid by the *Loess*, but is admirably adapted to the growth of fruit, and might be made a pomological paradise, under the management of those who know how to improve the favorable conditions which the hand of nature has so bountifully supplied. This portion of the county was originally covered with a heavy growth of timber, consisting of the usual varieties of oak, hickory, wild-cherry, etc.

Between Jerseyville and Fieldon, the surface is comparatively level, and the timber consists of the usual varieties of oak, hickory, ash, elm, linden, cherry, honey-locust, and black-walnut; and the valleys of the streams afford, in addition to these, cotton-wood, sycamore, white and sugar-maple, coffee-nut, hackberry, pecan, and white-walnut.

That portion of the county east of Jerseyville is underlaid by the Coal Measures, and is comparatively level, except the region traversed by the Piasa, where the surface is broken into sharp ridges, some of which are a hundred feet or more above the bed of the creek. The prairies are generally small, and are restricted to the north-eastern part of the county. They are covered with the deep black soil so characteristic of the prairies in central and northern Illinois; and in their productive qualities they are not surpassed by any other portion of the State. As an agricultural region, this county ranks among the best; and, taking into the account its proximity to the great rivers, its prospective railroad facilities, its varied and rich mineral resources, it must commend itself at once to the attention of those seeking a home in this State, as one of the most attractive and promising locations to be found. Fine springs of water are abundant in the limestone region; and good wells are obtained on the prairies at a depth of from twenty to forty feet. It is one of the finest wheat-growing counties in the State; and, from the varied character of the surface, it is adapted to the growth of all kinds of cereals and fruits that can be grown in this latitude. The broken lands in the vicinity of the river bluffs are well adapted to grape culture; and, if in the hands of skillful vine-growers, could be made to yield a more liberal return for the labor required to cultivate them than can be obtained from the richest prairie lands in the county, planted with the common cereals grown in this climate.

I can not close my report on this county without acknowledging my obligations to Dr. R. D. FARLEY and Mr. WILLIAM MCADAMS, Jr., for valuable assistance and important information in regard to some of the most interesting and important points in the county, and also for many acts of personal kindness and hospitality which I received at their hands while prosecuting my labors in this county. The State Cabinet is also indebted to them for several rare specimens, which they generously donated from their private cabinets.

# CHAPTER VII.

## GREENE COUNTY.

This county lies immediately north of Jersey, which forms its southern boundary, and is bounded on the west by the Illinois river, on the north by Scott and Morgan counties, and on the east by Macoupin county. It has a superficial area of about fifteen townships, or five hundred and forty square miles. It is well timbered and well watered, having, in addition to the river which forms its western boundary, Apple and Macoupin creeks, which, with their tributaries, traverse the county from east to west. Fine springs are also abundant along the river bluffs, and throughout the limestone region generally; and good wells are usually to be obtained on the uplands, at depths varying from thirty to forty feet.

The surface of the county is generally rolling; and the western portion, in the vicinity of the river bluffs, is quite broken and hilly, the valleys of the small streams being excavated to the depth of from one to two hundred feet below the general level of the uplands. In the central and eastern portions of the county, the depressions of the valleys are considerably less, seldom exceeding fifty or sixty feet below the general level. The prairies are small; and the county has an abundant supply of timber, of the same varieties observed and noticed in the report on Jersey county. The bluff lands are well adapted to the cultivation of fruit, as well as wheat and the cereals generally; and, in point of soil and agricultural capacities, this county is not much behind the adjoining county of Jersey; and the general remarks made with regard to the latter county, may be applied with equal propriety to this.

The completion of the St. Louis, Jacksonville and Chicago Railroad through this county, gives additional facilities for the cheap and rapid transportation of its agricultural products to market, for which it has heretofore been entirely dependent on the navigation of the Illinois river; and it will add materially to the value of the farming lands in the county, and to the general wealth and prosperity of its inhabitants.

## *General Geology of the County.*

The geological features of this county are by no means so varied as those presented in the adjoining county of Jersey, for the reason that the disturbing influences that have elevated the Devonian and Silurian beds above the surface, in that county, did not extend into this; and consequently we find no beds exposed here below the Lower Carboniferous limestones. The following vertical section of the several formations in the county will illustrate their general thickness and relative position :

| | | |
|---|---|---|
| Quaternary deposits, *Alluvium, Loess and Drift* | 100 to 120 | feet. |
| Coal Measures | 150 to 160 | " |
| St. Louis Limestone | 8 to 40 | " |
| Keokuk Limestone | 100 to 125 | " |
| Burlington Limestone | 120 to 150 | " |
| Kinderhook Group, (partial exposure). | 50 to 60 | " |

*Alluvium.*—The principal alluvial deposits in this county are those forming the bottom lands on the Illinois river, comprising a belt from three to five miles in width, and extending the whole length of the county from north to south. These lands are exceedingly fertile, and are among the most valuable and productive farming lands in the county. The greater portion of these bottom lands are prairie, sufficiently elevated to be susceptible of cultivation, and exceedingly productive. Adjacent to the river bluffs they are elevated entirely above high water mark, and are not subject to overflow from the annual river floods. Belts of heavy timber occupy some portions of these bottom lands, and skirt the small streams by which they are intersected. The varieties of timber observed in this county are the same that have been enumerated in the preceding chapter as occurring in Jersey county.

*Loess.*—This formation is usually confined to the vicinity of the river bluffs, which it caps to the depth of from forty to sixty feet, and gives origin to the bald grassy knobs, which form so notable a feature in the topography of the bluffs, both on the Illinois and the Mississippi. It is largely composed of beds of marly sand, which sustain a thick growth of wild grass, and occasionally a stunted growth of oak. It is unconformable to the Drift clays below it, and presents its greatest thickness immediately at the river bluffs, growing thinner toward the highlands of the adjacent region. It has been formed in the quiet waters of the lakes which once occupied the present valleys of the Illinois and the Mississippi rivers.

These marly beds of Loess form an admirable sub-soil, being sufficiently porous to allow a thorough drainage; and, where they underlie a gently rolling or tolerably level surface, they form a quick, warm and very productive soil.

*Drift.*—Some fine sections of Drift were seen in the bluffs of Bear creek, below Blanchard's coal bank, of forty to fifty to feet in thickness. The lower part was composed of bluish-colored clays, with small pebbles, and the upper part of the common reddish-brown clay, so generally characteristic of this formation. Large boulders of metamorphic rocks are not so abundant in the Drift of this region as in many other portions of the State; but a few were seen of moderate size, composed of green-stone, porphyry and granite, giving unmistakable evidence of their northern origin. Specimens of drifted copper and galena are also occasionally found in the clay and gravel beds of this region, which cover the whole surface of the county, except the valleys of the streams. These have been transported also from the north—the copper from Lake Superior, and the galena from the lead region of northern Illinois or Wisconsin, and were transported at the same period and by the same agency that brought the boulders of metamorphic rock.

*Coal Measures.*—The Coal Measures of this county comprise about a hundred and fifty feet in thickness of sandstones, shales, and thin bands of limestone, including three seams of coal, and comprise all the strata from the horizon of Coal No. 6 to the base of the measures, as they are developed in this portion of the State. The subjoined general section, compiled from many local sections in various parts of the county, will show their general thickness and relative position:

| | |
|---|---|
| Compact brown limestone | 2 to 4 feet. |
| Bituminous shale | 1 " |
| Coal No. 6 | 6 " |
| Shaly clay and nodular limestone | 3 to 4 " |
| Shale | 15 to 20 " |
| Bituminous shale | 2 to 3 " |
| Coal No. 5 | 2 to 3 " |
| Arenaceous shales and sandstone | 25 to 30 " |
| Bituminous shale, passing to Coal No. 3 ? | 2 to 3 " |
| Sandstone and shale | 40 to 50 " |
| Coal—Tulison's and Nettle's Coal No. 1 | 2 to 3 " |
| Nodular steel-gray limestone, sometimes replaced with fire-clay, as at Tulison's | 4 to 6 " |
| Shale and sandstone, passing locally into Conglomerate | 15 to 20 " |
| | 153 feet. |

The only outcrop of the Belleville or No. 6 coal, that was met with in this county, is on the north-east quarter of section 36, township 10, range 10, just on the county line between Greene and Macoupin, in the bluffs of Hodges' creek. This bank was owned and worked in 1864 by THOMAS RICE, and the seam is here very variable in its thickness, ranging from four to seven feet. The upper part of the seam is considerably mixed with sulphuret of iron, and is only fit for steam purposes; but the middle and lower portions afford a good smith's coal. The seam at this locality dips to the eastward; and this may probably be considered as its most westerly outcrop. There are only a few inches of shaly clay separating this seam from the nodular argillaceous limestone below, exhibiting here the phenomenon of a heavy seam of coal directly inclosed between beds of marine limestone. The nodular limestone below the coal abounds in fossils at this locality, among which a massive coral, the *Chaetetes milliporaceous*, is most conspicuous. This coral is generally hemispherical in form, and often attains a diameter of six to twelve inches. The limestone also contains many univalve shells belonging to the genera *Naticopsis*, *Pleurotomaria*, *Loxonema*, etc. Several species of these beautiful shells, from this locality, are figured and described in the second volume of this report.* The limestone which forms the roof of the coal is a compact bluish-gray rock, which weathers, on exposure, to a rusty-brown color, and contains *Productus longispinus*, *Spirifer lineatus*, *Fusulina*, and joints of *Crinoidea*.

Below this coal, there is another seam that outcrops on the creek in this vicinity. It has not yet been worked to any extent; and no good exposure of it was seen, but it is reported to be about two feet in thickness. It is undoubtedly the equivalent of coal No. 5, of the general section, and the Howlett coal near Springfield, but is much thinner here than the seam above it.

Bassett's coal, on the south-west quarter of section 27, township 10, range 11, is about eighteen inches in thickness; and the coal is overlaid, first by three or four feet of bituminous shale, and this by a septarian limestone, four feet or more in thickness. The coal is underlaid by a blue clay shale, from four to six feet thick, and this by a brown sandy shale, passing into sandstone, which outcrops down the creek for a distance of half a mile or more, and shows a thickness altogether of twenty-five or thirty feet. This seam probably overlies the coal at Tulison's, on Wolf Run, as well as that on Birch creek; but, as they were not met with on the same stream, that point could not be positively determined. I am inclined to believe that it represents coal No. 2 of the general section. The coal in this seam appears to be of good quality; but it is too thin to be profitably mined at the present time. At many points there is a heavy bed of sandstone intervening between this seam and the coal on Brush creek; and a similar bed, though perhaps a higher one in the series, is well exposed in the bluffs of Macoupin creek, at Rock bridge. The exposure here is from thirty-five to forty feet in thickness, the lower part consisting of blue sandy shales, which are overlaid by a massive brown sandstone, passing upward into a brown sandy shale. The sandstone is partly concretionary in structure, the concretions being quite hard, and forming a durable building stone. On Birch creek, a similar sandstone is well exposed, overlying coal-seam No. 1 with a thickness of twenty-five to thirty feet.

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* See vol. 2, plates 28 and 31, and pp. 354 to 381.

Nettle's coal-bank is on the north-east quarter of section 25, township 12, range 11, about eight miles north-east of Whitehall. The coal averages about three feet in thickness, and is overlaid by from three to five feet of bituminous shale, which forms a good roof to the coal. Above the shale, there is a bed of massive sandstone, twenty feet or more in thickness, similar to that at Rock bridge. Under the coal, there is a bed of shaly clay, not more than a foot or two in thickness, which rests upon a hard steel-gray nodular limestone, about four feet thick. These beds outcrop along the creek for a distance of about three miles above Nettle's place, the fall of the creek being just about equal to the dip of the coal, and in the same direction, which is to the south-east.

On Wolf Run, about a mile and a half east of Whitehall, a seam of coal outcrops along the creek for a distance of a mile or more, and has been opened at several points. It is from two feet to two and a half in thickness, and is a clear bright coal, breaking in regularly shaped blocks, and quite free from sulphuret of iron. It is overlaid by about two feet of bituminous shale, which passes upward into a blue clay shale, which is overlaid by sandstone. Below the coal there is an excellent bed of fire-clay, from eight to ten feet thick. The upper openings on this creek are on the lands lately owned by DAVID RANKIN, and the lower one on the lands of ISAAC TULISON.

On the south-east quarter of section 36, township 11, range 12, about four miles north-east of Carrollton, a coal-seam has been opened on the west fork of Whitaker's creek, which, with the associated rocks, forms the following section:

| | | | |
|---|---|---|---|
| COAL MEASURES. | Brown sandy shale | 10 to 12 | feet. |
| | Bituminous shale | 2 | " |
| | Coal | 1½ | " |
| | Shaly clay, passing downward into a sandy conglomerate | 10 to 15 | " |
| Band of iron ore | | 1½ | " |
| Hydraulic limestone | | 4 to 6 | " |
| Keokuk limestone | | 15 to 20 | " |

The beds above the band of iron ore in this section belong to the Coal Measures, and those below to the Lower Carboniferous limestone. It will be observed, in this section, that the St. Louis limestone, upon which the Coal Measures usually rest in this county, is not represented, unless it be by the bed of hydraulic limestone. The Keokuk limestone is well marked, presenting the usual characteristics that distinguish it at other localities. The iron ore above the hydraulic limestone is an earthy brown hematite of good quality.* The coal-seam is only about eighteen inches in thickness; and the work of mining it appeared to have been temporarily suspended. This coal has been opened on the east fork of Whitaker's creek, and also on Bear creek, on Mr. BLANCHARD'S place, about a mile and a half above the mouth of the creek.

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* For an analysis of this ore, see appendix to this volume.

Blanchard's coal bank is on the north-west quarter of section 14, township 11, range 11. The coal varies in thickness from two to three feet, and is overlaid by bituminous shale and massive sandstone. This seam appeared to be the same as Nettle's coal, on Birch creek. A mile and a half below Blanchard's, the St. Louis limestone is to be seen in the bluffs of the creek; but the intervening beds between the coal and the limestone are not exposed. In sinking the well for the steam mill at Carrollton, a thin seam of coal, about six inches thick, was said to have been passed through at a depth of about seventy feet below the surface. Although the Coal Measures underlie nearly all of the eastern half of the county, they comprise only the horizon of the lower coal seam, over a considerable portion of this area; and, along the extreme western borders of the coal-field, even this is too thin at many localities to be worked to advantage, and the eastern range of townships must be mainly relied on for a supply of coal. The measures in this county comprise the whole range of the productive Coal Measures, as they are developed in this portion of the State; but the two principal coals, Nos. 5 and 6, only extend a little over the eastern line of the county, and consequently underlie but a very small area in this county, while the lower part of the measures, which underlie all the eastern portion of the county, only have two of the four lower seams developed, and these range in thickness from eighteen to thirty-six inches. Hence Greene county is not as well supplied with coal as either Jersey or Macoupin; and the principal deposits are confined to the eastern portion of the county. The seam at Nettle's mine, on Brush creek, and at Blanchard's, on Bear creek, I regard as probably the same as the Exeter coal, in Scott county, and Tulison's bank, two miles north-east of Whitehall, may be referred to the same horizon. Burrows' coal probably holds a higher position, and perhaps represents either No. 2 or 3 of the general section of the Coal Measures in central and northern Illinois.

*St. Louis Limestone*.—This formation is quite variable in this county, both as regards its thickness and its lithological characters. On Link's branch, south of Carrollton, and about a half mile east of the State road from Carrollton to Jerseyville, a fine quarry has been opened in this limestone, on the lands of Mr. JOSEPH STOHR. The thickness of the rock at these quarries is about fifteen feet; and the lower ten is a heavy-bedded magnesian limestone, some of the layers being from two to three feet thick. The prevailing colors are light yellowish gray and brown; and these colors often replace each other in the same stratum. The rock is even-textured, free from chert or other silicious material, and dresses easily; and these quarries afford most of the cut stone used at Carrollton. The lowest strata seen at these quarries appeared to be a hydraulic limestone, and was about eighteen inches thick. At the crossing of the State road, a half mile further up the creek, the rock is not so even-textured, some of the strata being too hard to dress readily, and others too soft to stand exposure to the atmosphere. The whole thickness of the beds exposed, from the State road to Stohr's quarries, may be estimated at from twenty-five to thirty feet. In the upper part of this group, near the State road, there is also another stratum of what appeared to be a hydraulic limestone, about two feet thick.

On the road from Carrollton to Turpin's mill, this limestone is found outcropping in the beds of the small creeks that empty into the Macoupin. Turpin's mill is on section 16, township 9, range 11; and the St. Louis limestone is found well exposed on a small branch about a quarter of a mile west of the mill. The lower part of the bed, as it appears at this locality, is a brown arenaceous limestone, while the upper is of a gray and mottled color, and sufficiently pure to be burned for lime, though not a very good material for that purpose. The entire thickness of the beds exposed here is only about fifteen feet.

At Thompson's mill, on the north-east quarter of section 10, township 11, range 11, there is an exposure of about twelve feet of this formation. The upper four feet is a brown magnesian limestone, and the lower eight feet an earthy, grayish-brown hydraulic limestone, exactly resembling in appearance the hydraulic layers of this formation at other localities. This is the thickest bed of this kind of rock found in the county; and, if it should prove on trial to be as good a hydraulic rock as its appearance would indicate, it will become valuable for the manufacture of cement.* It is no doubt the equivalent of the hydraulic limestone noticed at the coal mine on the west fork of Whitaker's creek, and is here nearly twice as thick as at that locality. Fossils are quite scarce in this formation, at nearly every locality examined in this county. Some interesting forms of *Bryozoa* were obtained at the quarries on Link's branch, and we saw, in the cabinet of Dr. FARLEY, of Jerseyville, a fine specimen of *Conularia*, probably *C. Verneuiliana*, that was found at this locality.

*Keokuk Limestone.*—This formation, with the overlying St. Louis limestone, occupies a belt immediately beyond the western borders of the Coal Measures, and intervening between them and the Burlington limestone in the vicinity of the river bluffs. This belt is from three to four miles in width; and the Keokuk limestone, which forms the greatest portion of it, outcrops on the tributaries of Macoupin and Apple creeks, and on the last named creek itself, a half mile below the bridge, on the main road from Carrollton to Whitehall.

On the small creek, a half mile south of Whitehall, the upper part of the Keokuk limestone is found outcropping for a distance of a mile and a half or more on either side of the creek. The rock is here a thin-bedded, cherty, gray limestone, with thin partings of calcareo-argillaceous shale. It seldom affords strata more than six inches thick, and is therefore not a desirable building stone, except for light walls It affords some characteristic fossils at this locality, among which are *Archimedes Owenana*, *Platyceras equilatera*, *Agaricocrinus Americanus*, *Productus punctatus*, *Spirifer cuspidatus* and *S. Keokuk*. The fossils of this formation are not so numerous or so well preserved at the localities examined in this county as they are in the same beds in Jersey county.

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* For an analysis of this limestone, see the apperdix to this volume.

On the west fork of Whitaker's creek, these same beds are exposed, between the coal bank and the mouth of the creek, and afford the same varieties of fossils obtained in the vicinity of Whitehall. On Apple creek, a short distance below the bridge on the Carrollton and Whitehall road, the lower beds of this limestone are exposed, affording layers from twelve to eighteen inches thick. No point was found in the county where the whole of this formation could be seen in a single section; and, for a general description of its characteristic features, as well as the determination of its thickness, we have relied upon the results of local examinations of such portions of the formation as could be found exposed in different parts of the county. We have estimated its thickness, approximately, at one hundred to one hundred and twenty-five feet; but it may be somewhat greater even than that.

*Burlington Limestone.*—The outcrop of this formation is confined to the western part of the county. It forms the main portion of the river bluffs throughout the whole extent of the county, from north to south, and extends eastward from the bluffs, forming a belt from three to four miles in width. At the south line of the county, where Macoupin creek intersects the river bluffs, the lower part of this limestone, about seventy feet in thickness, forms the upper part of the bluff, and is underlaid by fifty-four feet of the ash-colored shaly limestones of the Kinderhook group. From this point to the north line of the county, this limestone is seen in a continuous exposure, except where intersected by the valleys of the small streams; and it often presents mural cliffs of limestone along the face of the bluffs, from seventy-five to a hundred feet in hight.

At JAMES J. ELDRIDGE's place, the limestone measures a hundred feet in thickness, above the road at the foot of the bluff, and is capped by a mound of Loess sixty feet high; and the bluffs very generally culminate in this vicinity in bald knobs, covered only with grass, giving a very picturesque outline to the landscape. The limestone at Eldridge's place is a light-gray crinoidal rock, in quite regular beds, with comparatively but little cherty material, and forms an excellent building stone, which is extensively used not only at this locality, but by the wealthy farmers occupying the bottom lands at the foot of these bluffs throughout the county, for dwellings and barns, and also for fences. About half a mile below the county line, between Greene and Scott, the limestone bluffs are about one hundred feet high, and are capped with forty feet of Loess.

At this point, there is a bench of brown limestone, projecting a few feet beyond the face of the bluff, and only a few feet above the base, that is covered with rude figures, cut upon the surface of the limestone by some of the aboriginal inhabitants of this country. Among these figures are the outlines of a human foot, and also that of a bear, several that were evidently designed to represent the tracks of birds, and others that do not appear to represent any natural object, but seem rather designed to record, in hieroglyphics, some historic or mythological events. These figures were cut upon the surface of the stone with some hard instrument, to the depth of perhaps one-sixteenth of an inch. The surface of the stone on which they were engraved, has been worn almost as smooth as glass, probably by the tread of human feet.

The bluffs of the Illinois and the adjacent bottoms appear to have been favorite resorts of some of the primeval races; and their rude antiquities, consisting of stone axes and knives, discs, flint arrow-heads, and an instrument resembling a mason's plummet, made apparently from the compact iron ore of the Iron Mountain in Missouri, are quite common in the counties of Greene, Jersey and Calhoun.

Fossils are not very numerous in the Burlington limestone, at the localities we examined in this county; but the following species were obtained: *Spirifer Grimesi*, *S. Forbesii*, *Athyris incrassata*, *A. lamellosa*, *Productus punctatus*, and *Actinocrinus concinnus*.

*Kinderhook Group.*—The upper half of this formation, including a thickness of about fifty feet, may be seen at the point where the Macoupin intersects the river bluffs; and this is the only exposure of the bed that we met with in the county. So far as could be seen, it consisted of ash-colored shales and shaly limestone, and afforded no fossils at this locality. Above this point, its outcrop along the bluff is hidden by the talus from the overlying beds.

## *Economical Geology.*

*Coal.*—About one-third of the entire surface of the county is underlaid by the Coal Measures; and they include the horizon of three or four coal-seams, though but two of these appear to be mined at the present time to any considerable extent. The upper one is the No. 6 or Belleville seam, which is only found along the east line of the county on Hodges' creek. It underlies but a very limited area in this county; and the exposures above named are probably nearly or quite on the western limit of its outcrop. We did not see it on Apple creek; but its line of outcrop would indicate that it might be found on that stream, in the vicinity of Athens. It is far the thickest and most valuable seam of coal that is developed in this part of the State, though at points further north the coal immediately below it (No. 5) is equally well developed, and attains an average thickness of about six feet. The lower two seams are comparatively thin, and no where exceed about three feet where they have been examined in this county.

No. 6 varies in thickness in this county from four to seven feet; while the lower seams, of which there are three, vary in thickness from one and a half to three feet. The two lower seams will probably be found to underlie nearly all the eastern portion of the county; and they will afford an abundant supply of coal for home consumption. The seam that outcrops on Birch creek is probably the same as that on Tulison's land, near Whitehall; and it may be mined at almost any point in the eastern part of the county, at a depth varying from fifty to one hundred and fifty feet below the surface Where it is desirable to mine it at a point where it does not outcrop at the surface, a boring should be first made to ascertain the thickness of the coal and its depth below the surface; and, when these points are determined, an exact calculation can be made of the expense of opening the mine, and the amount of coal it will afford to a given area. The expense of boring ought not to exceed two dollars per foot for the first one hundred and fifty feet. On Wolf Run and on Birch creek, where the lower seam is exposed, it will average two feet and a half in thickness, and will yield two and a half million tons of coal to the square mile. It is the same as the Exeter coal, in Scott county; and the coal it affords is generally better than the average quality, being quite as free from sulphuret of iron, in this county, as the No. 6 or Belleville coal. The seam at Bassett's, on the south-west quarter of section 27, township 10, range 11, appears to be of a local character, and can not be relied on as a productive bed, over a large area of surface. It was not met with any where else during our examinations of the county.

*Clays.*—The best clay for the potter's use, and for fire-brick, is the bed under the coal-seam on Wolf Run. At some points this clay is from eight to ten feet thick, and outcrops at the surface, at many localities, from one and a half to three miles from Whitehall. The thickness of this bed, and its proximity to the railroad, make this one of the most valuable deposits of potter's clay known in the State; and the near proximity of excellent coal, which may often be mined in the same drift with the clay, makes this one of the most desirable points for the manufacture of fire-brick or pottery, on a large scale, that can be found in the State. At Blanchard's mine no exposure of the clay under the coal is to be seen; and on Birch creek the coal-seam is underlaid by limestone, below which the beds were not seen; but in the vicinity of Winchester, and at some other localities in Scott county, the limestone below this coal is underlaid by a thick bed of nearly white clay, almost exactly like that east of Whitehall; and it is quite probable a similar clay may be found underlying the limestone on Birch creek.*

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* Specimens of this clay have been sent to Dr. Blaney, for analysis; and we hope to be able to give the result in the appendix to this volume.

*Hydraulic Limestone.*—The St. Louis limestone affords some layers that seem to possess hydraulic properties, at several localities in this county, though they are generally rather too thin to be of much value at the present time. The thickest bed seen in the county is at Thompson's mill, on Apple creek, where it is about eight feet in thickness. This locality would afford a sufficient amount of material to justify the erection of a cement mill at this point, should the rock prove, on trial, to be as well adapted to this purpose as its appearance would indicate.

*Iron Ore.*—On the west fork of Whitaker's creek there is a seam of iron ore underlying the coal at that locality, about eighteen inches in thickness. The ore is a hematite of a dark brick-red color, and appears to be of a good quality. Coal and limestone, for reducing it to metallic iron, are abundant in the vicinity of the ore.

*Limestone for Lime.*—The best material for this purpose, that we met with in this county, is that afforded by the light-gray semi-crystalline beds of the Burlington limestone, along the river bluffs. Some of these are a nearly pure carbonate of lime, and are not surpassed for this purpose by any limestone in the county. The lower part of the Keokuk limestone, as it appears below the bridge on Apple creek, will afford a very good limestone for this purpose; but the St. Louis group, which usually affords the purest limestone of all, affords no material adapted to this purpose at any of the localities we were able to examine in this county.

*Building Stone.*—All the principal limestone formations in this county afford good building stone for ordinary purposes; and some of them afford a superior article, suitable for cut-stone work and ornamental architecture. The most abundant supply, as well as the finest material of this kind, will be furnished by the Burlington limestone, which outcrops in the vicinity of the river bluffs. The rock is tolerably even-bedded, in strata varying from six inches to two feet in thickness, and can be very easily and cheaply quarried; so that it is now used, not only for all the ordinary purposes for which a building stone is required, but also for fencing the farms along the foot of the bluffs. Several elegant farm-houses have already been built in this county from this material; and, as the wealth of the country increases, something like a correct taste in architecture will obtain among the people, and a desire for more substantial and elegant buildings will be the result. This will give increased value to our supplies of fine building stone; and quarries that are now reckoned of little value to the owners will eventually become sources of wealth to an extent that can not at present be realized.

The St. Louis limestone will perhaps rank next in value for supplying the wants of the citizens of this county with good building stone. The quarries on Link's branch, near Carrollton, are capable of supplying the wants of that town and the surrounding country. The rock obtained at this locality is a yellowish-gray or brown magnesian limestone, soft enough to be cut with facility, when freshly quarried, and makes a fine building stone, either for cut-work or for heavy walls. Some of the beds are thick enough to furnish dimension-stone of a large size. At the present time (1864) the demand for this stone is limited to the vicinity of the quarries; but, when the railroad is completed to this point, this rock may be profitably furnished to distant and less favored localities. This bed will furnish a good material for heavy walls, at every locality where we saw it exposed in this county.

The Keokuk limestone will also furnish a very good building stone, wherever the lower part of the bed is found exposed. This portion of the bed affords layers of light bluish-gray, compact limestone, from six inches to a foot in thickness, that may be used for all the ordinary purposes for which material of this kind is required. In the upper part of the bed the layers are thin and cherty.

The sandstone overlying the coal-seam on Birch creek has all the characteristics of a reliable building stone. It is a massive micaceous sandstone, containing considerable ferruginous matter, withstands atmospheric influences well, and forms a bold mural wall along the bluffs of the creek, from fifteen to twenty feet in hight. It will furnish an abundant supply of building stone for this part of the county. On Bear creek, the sandstone is more unevenly bedded, and somewhat unevenly textured, some portions of it showing a disposition to crumble on exposure to the atmosphere. If quarried for building stone, where it presents this appearance, it should be selected with care; and the soft portions of the rock should be rejected. In a word, this county has an abundant supply of building stone, not only for the use of the inhabitants within its own borders, but also a large surplus for the supply of other portions of the State.

The agricultural resources of this county are very similar to those of Jersey county; and what we have said in relation to the soil and timber of that county would be equally applicable to this. The prairies are usually small; and all the streams are skirted with belts of excellent timber. Away from the river bluffs, the lands are generally level or gently rolling; and the soil is very productive. Corn and wheat are the great staples of this portion of the State; and the cultivation of these great cereals, and stock-raising, are the principal pursuits of the farmer. Since the completion of the railroad through this county, its market facilities are greatly increased, and the value of its rich farming lands correspondingly enhanced, since its products are made accessible to the best markets of the country, at all seasons of the year.

# CHAPTER VIII.

## SCOTT COUNTY.

This county lies immediately north of Greene, which forms its southern boundary, and it is bounded on the west by the Illinois river, and on the north and east by Morgan county. It embraces a superficial area of about seven townships, or two hundred and fifty-two square miles. A broad belt of alluvial bottom lands, from three to four miles in width, skirt the shore of the Illinois river, and extend from north to south throughout the county. These bottoms are mostly prairie, with narrow belts of timber skirting the streams. The middle portion of the county is generally rolling; and some portions of it adjacent to the river bluffs are broken and hilly. The eastern portion is comparatively level, and is interspersed with small prairies. More than one-half of the entire surface of the county was originally covered with a heavy growth of timber, embracing the usual varieties already enumerated in the counties south of this.

The ancient valley, now occupied by the Illinois river and its alluvial bottoms, was originally much wider through a considerable portion of the county than it is at the present time, and was excavated through solid limestone strata, to the depth of more than a hundred feet. This valley originally extended considerably farther east than the present line of river bluffs, through that part of the county lying south of the *Mauvais-terre*, down to within about a mile of the south line of the county; and the limestone strata have been entirely removed by erosion, their place being now occupied by accumulations of Loess and Drift, which form the bluffs; and it seems probable that the original valley was nearly or quite twice as wide at this point as the present one. The date of this erosion can not now be determined, farther than to state that it occured anterior to the accumulation of the Quaternary formation, and subsequent to the deposit of the Lower Carboniferous limestones.

In the vicinity of Moore's coal bank, on Sandy creek, we see unmistakable evidences of an erosion that must have taken place at a period anterior to the deposit of the Coal Measures, and subsequent to the formation of the Lower

Carboniferous limestones, because we find that the St. Louis limestone and the upper beds of the Keokuk limestone have been removed by erosive forces, and that the overlying Conglomerate of the Coal Measures is here made up in part of the fragments of the missing limestones, and rests unconformably on the *Archimedes* beds of the Keokuk series. It is perhaps impossible to determine at the present time whether or not these erosions of the limestone strata at the two localities cited are due to a single cause, and occurred simultaneously in time; but it seems quite probable that they did not, otherwise the coal-bearing strata should be found filling in part the ancient river valley in the place of the Quaternary. It seems more probable that they belong to two distinct and widely separated epochs, one of them dating back to the commencement of the coal period, and the other occurring much later, but anterior to the accumulation of the Quaternary deposits, and simultaneous with the formation of the principal valleys in which our large rivers now run.

From the point where the limestones disappear in the bluffs, about one mile above the south line of the county, to the *Mauvais-terre* creek, the Quaternary deposits are the only formation exposed in the vicinity of the bluffs, and these fill the eastern portion of this ancient valley, as before stated, to the depth of from one hundred to one hundred and twenty feet. Where these heavy accumulations of Quaternary beds occur, the surface is cut up into somewhat abrupt hills and ridges, as is seen in the vicinity of Glasgow, and especially west and north-west of that town. These lands, however, possess an excellent soil, and were originally heavily timbered with white-oak, hickory, ash, elm, walnut, sugar-maple, linden, wild-cherry, etc.; and, since they have been brought under cultivation, they prove to be among the most productive lands in the county. Wherever the land was originally covered with such a growth of timber as that just mentioned, there can be no question as to the superior quality and productive capacity of the soil; and these lands are really preferable, for most agricultural purposes, to the best prairie lands of the adjacent region.

In the geological structure of this county, we find but a slight variation from that presented by the adjoining county of Greene; and a general section of the strata will be found to present only this difference, that the Kinderhook group will be wanting at the base, and a few feet in thickness of Coal Measures near the top, cutting off coals No. 5 and 6, and their associated strata. The following section will show the relative thickness and order of superposition of strata in this county:

Nettle's coal-bank is on the north-east quarter of section 25, township 12, range 11, about eight miles north-east of Whitehall. The coal averages about three feet in thickness, and is overlaid by from three to five feet of bituminous shale, which forms a good roof to the coal. Above the shale, there is a bed of massive sandstone, twenty feet or more in thickness, similar to that at Rock bridge. Under the coal, there is a bed of shaly clay, not more than a foot or two in thickness, which rests upon a hard steel-gray nodular limestone, about four feet thick. These beds outcrop along the creek for a distance of about three miles above Nettle's place, the fall of the creek being just about equal to the dip of the coal, and in the same direction, which is to the south-east.

On Wolf Run, about a mile and a half east of Whitehall, a seam of coal outcrops along the creek for a distance of a mile or more, and has been opened at several points. It is from two feet to two and a half in thickness, and is a clear bright coal, breaking in regularly shaped blocks, and quite free from sulphuret of iron. It is overlaid by about two feet of bituminous shale, which passes upward into a blue clay shale, which is overlaid by sandstone. Below the coal there is an excellent bed of fire-clay, from eight to ten feet thick. The upper openings on this creek are on the lands lately owned by DAVID RANKIN, and the lower one on the lands of ISAAC TULISON.

On the south-east quarter of section 36, township 11, range 12, about four miles north-east of Carrollton, a coal-seam has been opened on the west fork of Whitaker's creek, which, with the associated rocks, forms the following section:

| | | | |
|---|---|---|---|
| COAL MEASURES. | Brown sandy shale | 10 to 12 | feet. |
| | Bituminous shale | 2 | " |
| | Coal | 1½ | " |
| | Shaly clay, passing downward into a sandy conglomerate | 10 to 15 | " |
| | Band of iron ore | 1½ | " |
| | Hydraulic limestone | 4 to 6 | " |
| | Keokuk limestone | 15 to 20 | " |

The beds above the band of iron ore in this section belong to the Coal Measures, and those below to the Lower Carboniferous limestone. It will be observed, in this section, that the St. Louis limestone, upon which the Coal Measures usually rest in this county, is not represented, unless it be by the bed of hydraulic limestone. The Keokuk limestone is well marked, presenting the usual characteristics that distinguish it at other localities. The iron ore above the hydraulic limestone is an earthy brown hematite of good quality.* The coal-seam is only about eighteen inches in thickness; and the work of mining it appeared to have been temporarily suspended. This coal has been opened on the east fork of Whitaker's creek, and also on Bear creek, on Mr. BLANCHARD'S place, about a mile and a half above the mouth of the creek.

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* For an analysis of this ore, see appendix to this volume.

Blanchard's coal bank is on the north-west quarter of section 14, township 11, range 11. The coal varies in thickness from two to three feet, and is overlaid by bituminous shale and massive sandstone. This seam appeared to be the same as Nettle's coal, on Birch creek. A mile and a half below Blanchard's, the St. Louis limestone is to be seen in the bluffs of the creek; but the intervening beds between the coal and the limestone are not exposed. In sinking the well for the steam mill at Carrollton, a thin seam of coal, about six inches thick, was said to have been passed through at a depth of about seventy feet below the surface. Although the Coal Measures underlie nearly all of the eastern half of the county, they comprise only the horizon of the lower coal seam, over a considerable portion of this area; and, along the extreme western borders of the coal-field, even this is too thin at many localities to be worked to advantage, and the eastern range of townships must be mainly relied on for a supply of coal. The measures in this county comprise the whole range of the productive Coal Measures, as they are developed in this portion of the State; but the two principal coals, Nos. 5 and 6, only extend a little over the eastern line of the county, and consequently underlie but a very small area in this county, while the lower part of the measures, which underlie all the eastern portion of the county, only have two of the four lower seams developed, and these range in thickness from eighteen to thirty-six inches. Hence Greene county is not as well supplied with coal as either Jersey or Macoupin; and the principal deposits are confined to the eastern portion of the county. The seam at Nettle's mine, on Brush creek, and at Blanchard's, on Bear creek, I regard as probably the same as the Exeter coal, in Scott county, and Tulison's bank, two miles north-east of Whitehall, may be referred to the same horizon. Burrows' coal probably holds a higher position, and perhaps represents either No. 2 or 3 of the general section of the Coal Measures in central and northern Illinois.

*St. Louis Limestone*—This formation is quite variable in this county, both as regards its thickness and its lithological characters. On Link's branch, south of Carrollton, and about a half mile east of the State road from Carrollton to Jerseyville, a fine quarry has been opened in this limestone, on the lands of Mr. JOSEPH STOHR. The thickness of the rock at these quarries is about fifteen feet; and the lower ten is a heavy-bedded magnesian limestone, some of the layers being from two to three feet thick. The prevailing colors are light yellowish gray and brown; and these colors often replace each other in the same stratum. The rock is even-textured, free from chert or other silicious material, and dresses easily; and these quarries afford most of the cut stone used at Carrollton. The lowest strata seen at these quarries appeared to be a hydraulic limestone, and was about eighteen inches thick. At the crossing of the State road, a half mile further up the creek, the rock is not so even-textured, some of the strata being too hard to dress readily, and others too soft to stand exposure to the atmosphere. The whole thickness of the beds exposed, from the State road to Stohr's quarries, may be estimated at from twenty-five to thirty feet. In the upper part of this group, near the State road, there is also another stratum of what appeared to be a hydraulic limestone, about two feet thick.

On the road from Carrollton to Turpin's mill, this limestone is found outcropping in the beds of the small creeks that empty into the Macoupin. Turpin's mill is on section 16, township 9, range 11; and the St. Louis limestone is found well exposed on a small branch about a quarter of a mile west of the mill. The lower part of the bed, as it appears at this locality, is a brown arenaceous limestone, while the upper is of a gray and mottled color, and sufficiently pure to be burned for lime, though not a very good material for that purpose. The entire thickness of the beds exposed here is only about fifteen feet.

At Thompson's mill, on the north-east quarter of section 10, township 11, range 11, there is an exposure of about twelve feet of this formation. The upper four feet is a brown magnesian limestone, and the lower eight feet an earthy, grayish-brown hydraulic limestone, exactly resembling in appearance the hydraulic layers of this formation at other localities. This is the thickest bed of this kind of rock found in the county; and, if it should prove on trial to be as good a hydraulic rock as its appearance would indicate, it will become valuable for the manufacture of cement.* It is no doubt the equivalent of the hydraulic limestone noticed at the coal mine on the west fork of Whitaker's creek, and is here nearly twice as thick as at that locality. Fossils are quite scarce in this formation, at nearly every locality examined in this county. Some interesting forms of *Bryozoa* were obtained at the quarries on Link's branch, and we saw, in the cabinet of Dr. FARLEY, of Jerseyville, a fine specimen of *Conularia*, probably *C. Verneuiliana*, that was found at this locality.

*Keokuk Limestone.*—This formation, with the overlying St. Louis limestone, occupies a belt immediately beyond the western borders of the Coal Measures, and intervening between them and the Burlington limestone in the vicinity of the river bluffs. This belt is from three to four miles in width; and the Keokuk limestone, which forms the greatest portion of it, outcrops on the tributaries of Macoupin and Apple creeks, and on the last named creek itself, a half mile below the bridge, on the main road from Carrollton to Whitehall.

On the small creek, a half mile south of Whitehall, the upper part of the Keokuk limestone is found outcropping for a distance of a mile and a half or more on either side of the creek. The rock is here a thin-bedded, cherty, gray limestone, with thin partings of calcareo-argillaceous shale. It seldom affords strata more than six inches thick, and is therefore not a desirable building stone, except for light walls It affords some characteristic fossils at this locality, among which are *Archimedes Owenana*, *Platyceras equilatera*, *Agaricocrinus Americanus*, *Productus punctatus*, *Spirifer cuspidatus* and *S. Keokuk.* The fossils of this formation are not so numerous or so well preserved at the localities examined in this county as they are in the same beds in Jersey county.

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* For an analysis of this limestone, see the apperdix to this volume.

On the west fork of Whitaker's creek, these same beds are exposed, between the coal bank and the mouth of the creek, and afford the same varieties of fossils obtained in the vicinity of Whitehall. On Apple creek, a short distance below the bridge on the Carrollton and Whitehall road, the lower beds of this limestone are exposed, affording layers from twelve to eighteen inches thick. No point was found in the county where the whole of this formation could be seen in a single section; and, for a general description of its characteristic features, as well as the determination of its thickness, we have relied upon the results of local examinations of such portions of the formation as could be found exposed in different parts of the county. We have estimated its thickness, approximately, at one hundred to one hundred and twenty-five feet; but it may be somewhat greater even than that.

*Burlington Limestone.*—The outcrop of this formation is confined to the western part of the county. It forms the main portion of the river bluffs throughout the whole extent of the county, from north to south, and extends eastward from the bluffs, forming a belt from three to four miles in width. At the south line of the county, where Macoupin creek intersects the river bluffs, the lower part of this limestone, about seventy feet in thickness, forms the upper part of the bluff, and is underlaid by fifty-four feet of the ash-colored shaly limestones of the Kinderhook group. From this point to the north line of the county, this limestone is seen in a continuous exposure, except where intersected by the valleys of the small streams; and it often presents mural cliffs of limestone along the face of the bluffs, from seventy-five to a hundred feet in hight.

At James J. Eldridge's place, the limestone measures a hundred feet in thickness, above the road at the foot of the bluff, and is capped by a mound of Loess sixty feet high; and the bluffs very generally culminate in this vicinity in bald knobs, covered only with grass, giving a very picturesque outline to the landscape. The limestone at Eldridge's place is a light-gray crinoidal rock, in quite regular beds, with comparatively but little cherty material, and forms an excellent building stone, which is extensively used not only at this locality, but by the wealthy farmers occupying the bottom lands at the foot of these bluffs throughout the county, for dwellings and barns, and also for fences. About half a mile below the county line, between Greene and Scott, the limestone bluffs are about one hundred feet high, and are capped with forty feet of Loess.

teeth. It is overlaid by about eight feet of shaly limestone, without fossils. At **Henry Smith's** place, scarcely a half mile above the locality just described, extensive quarries have been opened for building stone. The rock is here mainly an even-bedded, greenish-gray sandstone, with some thin layers of magnesian limestone, and is an excellent building stone. A half mile below Bluff City, a similar rock has been quarried for the construction of culverts on the railroad. At this point, the sandstone contains many fragments of plants, and resembles, and might be easily mistaken for, a Coal Measure sandstone. About a mile east of Bluff City, near Vangundy's, we find regular beds of gray limestone, belonging to the St. Louis series, outcropping in the bluffs of the creek, and presenting the usual characters of the calcareous beds of this formation. From what has been said of the various outcrops of this limestone in this county, it will be seen that it is exceedingly variable in its appearance and lithological characters; and, if an observer was to meet with it for the first time in this county, he would most likely be somewhat puzzled by the peculiar features that would be presented for his examination; for we here find the commencement of certain lithological changes in the character of this formation, which, on the eastern borders of the coal-field, extend into the lower groups, and merge nearly the whole of the Lower Carboniferous limestone series into green shales and shaly sandstone.

*Keokuk Limestone.*—The only exposure of any considerable portion of this limestone met with in this county was on the Little Sandy, where it directly underlies the Coal Measures. The rock at this exposure is quite thin-bedded and cherty; and not more than ten or fifteen feet in thickness was to be seen here. At the river bluff, on the Exeter and Naples road, there is an exposure of about thirty-five feet of calcareo-argillaceous shales, with geodes, which no doubt represent the upper part of this formation. About the middle of the bed, at this locality, there is a band of hard brown magnesian limestone, about two feet thick, which contains *Hemipronites crenistria*, *Spirifer Keokuk*, *Productus punctatus*, etc. These beds undoubtedly belong above those that outcrop on the Little Sandy. The lower part of this limestone we did not find exposed at any of the localities examined in this county.

*Burlington Limestone.*—A half mile above the south line of the county, on **William T. Collins'** place, there are about one hundred and twenty feet of this limestone exposed in the river bluffs; and it is overlaid by from fifty to sixty feet of Loess. The limestone here presents its usual characters of alternating beds of light-gray and brown limestone, with some cherty material in seams and nodules. This limestone appears along the bluffs for about a mile above the Greene county line, when it disappears; and the mural bluffs, which it forms wherever it is found, give place to rounded hills of Loess and Drift. About a half mile south of Glasgow, this limestone is again seen on a small branch of the Big Sandy, in an exposure about fifty feet in thickness, where it presents the same general characters as at the locality first noticed. The upper part of the mass is quite cherty here, and is comparatively worthless for economical purposes; but the lower part affords massive beds of gray and brown limestone of good quality. Fossils were more abundant at this locality than in the river bluffs; and we found the following species: *Spirifer Grimesi, S. plenus, Orthis Michilini, Athyris lamellosa, Actinocrinus Christyi, A. Verneuilianus, A. Missouriensis, A. multiradiatus,* and undetermined species of *Cyathocrinus* and *Agaricocrinus.*

## *Economical Geology.*

*Coal.*—More than one half of the entire surface of the county is underlaid by the Coal Measures; and, although these measures only include the horizon of three seams of coal, only one of which appears to be developed over any considerable extent of surface, yet the Exeter seam alone, which is the most reliable one in this county, will furnish an ample supply for all local demands. From its position at the very base of the measures, it must necessarily underlie the whole extent of surface which the Coal Measures cover, and no natural exposure of the proper horizon for this coal was seen; but the coal itself was present. The seam varies in thickness from two to three feet, and has a good slate roof that admits of the removal of all the coal, and requires only a moderate expense for cribbing; and the coal it affords is better than an average of the Illinois coals in quality. In the summer of 1853, while engaged in making a preliminary examination of the counties adjacent to the Illinois river, I found that "Frost's coal" had a wide-spread reputation throughout the adjoining counties on both sides of the river as the best smith's coal in this portion of the State; and I fully expected, on reaching the locality of this celebrated coal, to find that it was furnished by a different seam from any that was worked in the adjacent region. But, on reaching Frost's mine, I was somewhat surprised to find that his celebrated smith's coal was obtained from the same seam that I had been tracing through the adjoining counties, and that its enviable reputation was solely due to the judicious manner in which the mine was worked. The top coal, which was quite free from sulphuret of iron, was separated from the inferior portion in mining; and the different qualities of coal were sold at different prices and for the special uses to which they were best adapted. If the coal-miners and dealers generally in this State would adopt a similar system, it would tend to greatly improve the reputation of the Illinois coals wherever they are used. Three analyses were made by Mr. PRATTEN, of coals from this seam in Scott county, with the following result:

*Barker's Coal.*

| | | |
|---|---|---|
| Specific gravity | | 1.2396 |
| Loss in coking | 42.8 | |
| Total weight of coke | 57.2 | —100.00 |
| Moisture | 5 5 | |
| Volatile matters | 37 3 | |
| Carbon in coke | 52 2 | |
| Ashes (light brown) | 5.0 | —100.00 |

*Exeter Mine.*

| | | |
|---|---|---|
| Specific gravity | | 1.288 |
| Loss in coking | 42.37 | |
| Total weight of coke | 57 63 | 100.00 |
| Moisture | 12.10 | |
| Volatile matters | 30 27 | |
| Carbon in coke | 50 13 | |
| Ashes (red) | 7.50 | 100.00 |

*Frost's Coal.*

| | | |
|---|---|---|
| Specific gravity | | 1.2883 |
| Loss in coking | 46.37 | |
| Total weight of coke | 53.63 | 100.00 |
| Moisture | 8 50 | |
| Volatile matters | 37.87 | |
| Carbon in coke | 46.53 | |
| Ashes (red) | 7.10 | 100.00 |

It is but just to add that these analyses were made from selected specimens of these coals, and may be taken as fairly representing that part of the seam affording the smith's coal. Barker's mine is two miles and a half north-east of Winchester, on the south-east quarter of section 22, township 14, range 12. The coal at this locality averages about thirty inches in thickness, and has a good slate roof. This seam of coal will yield about two and a half million tons to the square mile, and probably underlies as much as three townships, or one hundred and eight square miles in this county.

*Clays.*—The most extensive and valuable deposit of clays to be found in this portion of the State is that underlying the Exeter coal-seam. In the vicinity of Winchester, it is from ten to twelve feet in thickness, and is most readily procured from those localities where the overlying strata have been removed by erosion, and the clay has been subjected to atmospheric influences during the Drift period, which have had a favorable effect in rendering it fit for immediate use. The same effect may also be produced by throwing it out of the bed, and exposing it for several months to atmospheric influences. It sometimes appears as a regularly stratified clay shale, and again as an unstratified fire-clay. Its color is a light ashy-gray, inclining to yellow. It outcrops along the western borders of the coal-field, sometimes lying immediately under the Exeter coal, and at other localities separated from the coal by the steel-gray nodular limestone already noticed. It varies in thickness from three to twelve feet, and was found at every locality in this county where the base of the Coal Measures was exposed; and its near proximity to the coal adds materially to its value. It will afford an inexhaustible supply of material suitable for the manufacture of drain-tile, potter's ware, and fire-brick. The brown sub-soil clays upon the uplands every where furnish material suitable for the manufacture of common brick; and the sand necessary for the same purpose, and for mortar, is abundantly supplied from the beds of modified Drift in the valleys.

*Iron Ore.*—Bands of hematite iron ore were found at two localities in this county, one of which was at Moore's coal mine, on Little Sandy. At this point, there are two bands of nodular ore, from six inches to a foot in thickness, in the shales between the potter's clay and the Lower Carboniferous limestones. At about the same horizon, there is a similar band in the vicinity of Exeter, which is about a foot in thickness. These hold the same stratigraphical position as the iron bands noticed on Whitaker's creek, in Greene county. They are probably too thin at these localities to be profitably mined at the present time.

*Hydraulic Limestone.*—At several localities in this county, the St. Louis limestone affords beds of earthy buff-colored or yellowish-gray limestone, that presents all the usual characteristics of a hydraulic rock, some of which will no doubt become valuable for the manufacture of cement. We have been unable to obtain an analysis of these limestones in time to be incorporated in this report; and it will perhaps be sufficient for the present to direct the attention of those owning the quarries to the fact of their occurrence here, that they may test by actual experiment their fitness for hydraulic purposes. At the quarries about a mile south-west of Winchester, and at the hill on the Naples road, a half mile west of Exeter, beds of this kind were observed; and they may no doubt be found at other localities in the county.

*Limestone for Lime.*—The Burlington limestone, which forms the river bluff in the south-west part of the county, will furnish an ample supply of material for this purpose, which, if not equal to that made from the St. Louis limestone, will afford a very good lime for mortar and for all ordinary uses. In the vicinity of Winchester, the evenly-bedded, bluish-gray limestone of the St. Louis series will afford a superior article of lime, and an abundant supply for all the eastern portion of the county. The same beds in the vicinity of Exeter are equally well adapted for this purpose.

*Building Stone.*—This county is generally well supplied with good building stone, especially in the middle and western portions. From Glasgow south and west to the river bluffs and the Greene county line, the Burlington limestone outcrops on all the streams, forming limestone bluffs from fifty to a hundred feet in hight. The rock is a massive light-gray or brown crinoidal limestone, and often affords strata two feet or more in thickness, which dress easily and form an excellent and durable building stone. Owing to the expense of transportation, until additional facilities are obtained, its use will necessarily be restricted to the south-western part of the county. The St. Louis limestone also affords good building stone, especially for foundation walls and heavy masonry, such as abutments and culverts, to which the brown magnesian beds of this formation are well adapted. Along the river bluffs above the *Mauvais-terre*, the arenaceous beds of this formation are generally used, and make a good building stone. The middle and eastern portions of this county, within the area of the coal-field, may be supplied to some extent from the sandstone overlying the Exeter coal-seam, which, at many localities, will be found to afford a durable stone. But in all cases a Coal Measure sandstone should be selected with much care, where it is used as a building stone, and always rejected if it does not stand exposure well at the natural outcrop of the bed.

In natural resources, and all the material elements of wealth, it will be seen, from what has already been said, that Scott county ranks among the most favored in this portion of the State. With a soil of unsurpassed fertility, an abundant supply of excellent timber, with bituminous coal of good quality, and building stone, potter's clay, etc., in abundance, it would be difficult to find a locality where greater inducements are offered to the industrious and enterprising emigrant, who is seeking a home within the borders of our highly favored State, than are to be found in this county.

Although there is no railroad passing directly through the county, yet the Jacksonville, Alton and St. Louis railroad crosses the south-east corner of the county, and the Naples branch of the Great Western road the north-west corner, while the main portion of the county occupies the triangular area between them. The Illinois river, which forms its western boundary, affords a cheap outlet, by water transportion, for all the agricultural products of the county. The wide beds of bottom lands, adjacent to the Illinois river, possess a very fertile soil, and produce annually large crops of corn and other cereals, and, where sufficiently elevated to be above the level of the annual overflows, will perhaps yield a more liberal return for the labor expended in their cultivation than any other lands in the county.

# CHAPTER IX.

## WASHINGTON COUNTY.

BY HENRY ENGELMANN.

Washington county is bounded on the west by St. Clair county, on the north by Clinton county, on the east by Jefferson county, and on the south by Randolph and Perry counties. It embraces, in the main, townships 1, 2, and 3, south of the Baseline, in ranges 1, 2, 3, 4, and 5 west of the third principal meridian; but only its west, south and east lines are straight. The northern boundary line, which separates it from Clinton county, follows the Okaw or Kaskaskia river to the mouth of Crooked creek; then, the latter to near the mouth of Grand-point branch; then, a section line two miles north of the base line, through township 1 north, range 1 west, to the third principal meridian. The county thus embraces an area of a little over fifteen townships, or about five hundred and fifty-seven square miles. A little more than one-half of this, or about fifty-two per cent., is prairie.

The counties west and south of Washington county—St. Clair and Perry—are considered amongst the richest in the State for their inexhaustible wealth of stone-coal. The coal-bearing strata of these counties dip to the east and northward, underneath those of Washington county; and we may, therefore, very properly conclude that the coal-seams of those counties extend also into this county, only at greater depth. Hence, the geological formation of this county is the upper Coal Measures, embracing strata that range higher in the geological series than any discovered in St. Clair and Perry counties.

*Surface-configuration.*—The surface of the county is considerably diversified, and is watered by numerous streams. In the northern and western parts, the water-courses run into the Kaskaskia river, and are designated as follows: Grand-point creek, Crooked creek, Little Crooked creek, Plum creek, Elkhorn creek; and in the south-west, Mud creek. The southeastern part of the county is drained toward the Big Muddy river by Locust branch, Beaucoup creek, and Little Muddy river. The whole width of the county is only eigh-

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teen miles; and the ascent from the Kaskaskia river to the dividing ridge, which passes a little beyond the middle of the county, is therefore considerable, and produces the principal inequalities of surface-configuration observed in the county. The whole south-eastern half of the county is high land, embracing the dividing ridge between the different systems of drainage; and spurs of that ridge extend northward and southward between the principal tributaries of the larger streams.

The prairies occupy all the flat or rolling land at some distance from the main streams, while the low bottom lands along the water-courses, and some of the high lands next adjoining them, are covered with forest, as well as the more broken portions of the ridges near the upper courses of the streams, where these have cut their channels deep into the hills. The prairies are therefore of two classes—those that are a little elevated and rather level near the lower course of the streams, and more elevated and rolling prairies on the higher ridges. The latter are the so-called "ridge prairies," while the former are sometimes designated as "bottom prairies."

Beginning in the south-west corner of the county, we have first an arm of Grand Coti prairie—a regular ridge-prairie between the tributaries of Kaskaskia and Beaucoup rivers. Then comes Mud prairie, a rather low and flat prairie between Mud creek and its tributary, Little Mud creek. Next follows Elkhorn prairie. Its north-western end, near Kaskaskia river and the lower course of Elkhorn creek, is several miles wide, rather flat, and not much elevated; but it increases in elevation toward the south-east, and continues as a narrow ridge-prairie, with steep breaks at its margin, round the head of Elkhorn creek, and between it and the branches of Mud creek and Swanwick creek. Then its name is changed into Nashville prairie or Grand prairie. Grand prairie is a wide, flat and moderately elevated upland prairie, in the neighborhood of the Kaskaskia river, between the lower Elkhorn creek and Little Crooked creek; but it rises toward the south, and forms a high prairie ridge, which is most conspicuous from near the head of Plum creek, toward Nashville. This prairie ridge continues eastward toward Richview, forming the summit of the divide between the various tributaries of the Kaskaskia and Big Muddy rivers. It also sends off branches west and east of Grandpoint creek, and south-eastward beyond Ashley. These are all known as Grand prairie, and become lower and flatter toward the lower course of the creeks, especially toward Crooked creek. Beside these main prairies, we find some smaller ones between the branches of Elkhorn creek—one on the ridge between the Beaucoup and Locust branch; then Three-mile prairie, somewhat lower down on the west side of Locust branch; and finally, in the extreme south-east part of the county, another, called Mud prairie—a flat ridge-prairie between Beaucoup and Little Muddy rivers.

The timbered portion of Washington county, especially in the southern part, where the timber prevails largely over the prairie, closely resembles in every respect the adjoining districts of Perry county. We have here the same post-oak flats wherever the ridges are sufficiently level; the oak and grass barrens, where they are more rolling and broken; and the older forests, where the land is most broken. Thus we find post-oak flats on the north side of Mud creek, south-east of Mud prairie; then east of Elkhorn creek, near the Little prairie; between Locust branch and Watering branch; between Locust branch and the Beaucoup; east of the latter, toward Dry prairie and Mud prairie; and east of the Little Muddy. In the northern part of the county, the extent of timber is much more limited, and is chiefly confined to the bottom lands of the streams, and to narrow belts of land between them and the prairies.

In conformity with the predominating prairie character of the county, and on account of the softness of most of the strata, outcrops of rocks are quite scarce, and rocky cliffs are only developed on a small scale; and on several of the creeks hardly a single outcrop of rocks has been discovered. At a few points a considerable thickness of rock is exposed, although seldom in a continuous outcrop. On the upper course of Mud creek, and on its branches, I observed considerable outcrops of rocks, while in its lower course, even in this county, it is confined between banks of clay. Of Elk-horn creek we can say the same. In its upper course it has worn its channel through the same strata as Mud creek, and winds its tortuous way past many a bold cliff of rock. On Little Mud creek, on the contrary, we find only a single small exposure. On Kaskaskia river, as far as it forms the boundary of this county, and for a considerable distance above and below, only a single small outcrop of rocks is known, and but two, close together, on Crooked creek. Little Crooked creek and Grand-point creek have each a few hardly perceptible outcrops far apart along their banks. On the branches of Swanwick creek, and on Locust branch, we do not find a single one; but there are some on Watering branch, and on the upper course of the Beaucoup, and the same ledges make their appearance also at several points on Little Muddy river.

## *Geological Formations.*

The upper part of the Coal Measure formation prevails all over Washington county, to the exclusion of all other strata except the Quaternary deposits covering the surface. It contains only some thin seams of coal, and overlies the Lower Coal Measures, the coal-bearing formation of Perry and St. Clair counties. This latter formation undoubtedly extends underneath the strata of Washington county, and thus far we have no reason whatever for doubting that the coal-beds, which are found in the adjoining counties, may also extend under Washington county, only at a greater depth, and that they may be opened and worked whenever a sufficient demand for coal has been created to warrant the necessary outlay of capital.

### SECTION OF THE COAL MEASURE STRATA.

(IN DESCENDING ORDER).

1. *The Upper Sandstone Formation.*—It consists principally of sandstones and arenaceous and argillaceous shales, with some calcareous intercalations. These latter do not form heavy ledges, but either thin layers of rather pure or slaty limestone, or else heavier layers of very much mixed rock, of calcareous sandstone or mudstone. Such is the rock at Joliff's mill, on Crooked creek, which is supposed to be about sixty-two feet above the base of this division, but is perhaps a higher stratum. Another calcareous ledge is found in the upper part of this formation in Washington county, together with a seam of stone-coal from eight to twelve inches in thickness. Some coal has also been observed irregularly distributed through a sandstone, sixty or seventy feet above the base of this division. The aggregate thickness of this upper sandstone formation in Washington county is estimated at between two hundred and two hundred and fifty feet.*

2. *The Shoal Creek Limestone*—A light-colored, grayish or bluish, compact, close-textured limestone, averaging seven feet in thickness, which is remarkable for its uniform development over a wide range, far beyond the limits of this county, whereby it affords a marked division line in the series of formations.

3. *The Slaty Division.*—Below the Shoal creek limestone generally follow some two or three feet of black laminated slate, which at some points contains a thin streak of coal; then shales, arenaceous shales or sandstones; and finally more slates, generally with a thin layer of slaty limestone or merely with calcareous concretions, and a stratum of coal from eight to sixteen inches in thickness. This slaty division varies in thickness from fifteen to fifty feet.

4. *The Lower Sandstone Formation.*—It consists mainly of sandstones and arenaceous and argillaceous shales, and corresponds to the sandstone formation of the upper part of the Coal Measures of St. Clair and Perry counties. Its

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* We are at a loss to know on what evidence the above estimate is based, for in the section of the Nashville shaft, given on a following page, which is sunk at one of the most elevated points in the county, and through superficial deposits only eleven feet in thickness, we find that but sixty-nine feet of strata, including sandy and argillaceous shales, sandstone and impure limestone, were passed through above the Shoal creek limestone; and at Richview, a limestone supposed to be the Shoal creek bed, was passed through in the shaft at that point, at a depth of one hundred and twenty feet; but, as the thickness of the superficial clays in this shaft is not stated, we cannot know exactly the thickness of these upper shales at that point. They are probably, however, not over one hundred feet thick, and this would no doubt be a much nearer approximation to the aggregate thickness of the strata above the Shoal creek limestone in this county than that given above. A. H. W.

aggregate thickness amounts to two hundred and seventy feet. Its lower portion is prevalingly shaly, while in its upper half, at Nashville, seventy feet below its upper end, it contains a calcareous stratum which generally has the appearance of a pudding-stone, composed of limestone and sandstone, but at other points forms a ledge of rather pure limestone, underneath which we find more or less stone-coal, usually forming a seam of from six to twelve inches in thickness. At many points the lime is thoroughly mixed with the sand, so that we only find hard calcareous sandstones. There are probably other local intercalations of calcareous matter in this formation.

The lowest strata of the series which actually crop out in Washington county, are found in its western and south-western parts. On Little Mud creek, a quarter of a mile east of the St. Clair county line, in the north-west quarter of section 19, and a little higher up the creek, near the south line of section 18, township 2, range 5, some irregularly and thinly stratified and rather solid sandstone is barely exposed to view in the bed of the creek, and these are the only outcrops along it. The same layer has been struck in Mud prairie, a mile and a half farther south, near Mr. C. BENNER'S, in the north-west quarter of the south-west quarter of section 30, at a depth of thirty feet. Still farther south, in the north-west quarter of section 31, it appears that some slaty shales, with kidney iron ore, were found in a well above the sandstone. Such shales, partly slaty, partly arenaceous, have been struck at numerous points farther east in this prairie, in the east part of section 29 and in the north-east quarter of section 32, in section 33, and in the adjoining township 3, range 5, in the east part of section 4, in the west part of section 3, and on much higher ground in the north-east quarter of section 3. Generally, they have not been penetrated more than a few feet, and they seem to present an uneven surface, because at other points, sometimes only a few yards distant, water has been found in quick-sand and no rock discovered.

At the south side of Mud prairie, sandstone, corresponding apparently to that mentioned above, has also been struck in a well in the north-east quarter of section 18, township 3, range 5, at a depth of twenty feet; but on Mud creek itself, no rocks are exposed in the west part of this township; and the first outcrop which I noticed in its banks consists of the argillaceous shales, with kidney ore and other concretions, in the north-west quarter of section 22. On the higher ground, in the barrens south of Mud creek, west and east of the arm of Grand Coti prairie, in the south part of township 3, range 5, in which no rock is struck in the wells, sandstones are exposed at various points, and might be found any where at a little depth by digging. They have been quarried close to the St. Clair county line, in the south-west corner of section 19, where they are of a light-greenish-yellow color, and closely resemble those quarried some miles east of Athens, in St. Clair county, of which they undoubtedly form the continuation. They were also noticed in a ravine in the north-east corner of section 31, where it has been ascertained by boring that they overlie dark-colored shales with kidney ore; and I saw them exposed in the south part of section 22, and in sections 26, 35 and 36, where they are generally of a light-brownish color. In the barrens north of Mud creek, in the north-east part of township 3, range 5, exposures of rocks are more scarce, but I noticed the sandstones on a branch in the south-east quarter of section 11, and at a few other points. The first outcrop of these strata on the the main creek was observed in the south part of section 23, where it forms an overhanging cliff at the water's edge, more than twelve feet high. Thence, up the creek, we meet with an occasional rocky bluff.

In the adjoining township, 3, range 4, this formation is more exposed. The sandstone has been struck in several wells in the south-west part of the Elkhorn prairie, on the side toward Mud creek. In the north-west corner of section 21, township 3, range 4, a well, eighty feet deep, passes mainly, if not exclusively, through sandstone, from twenty feet below the surface downward. In its lower part, a few scattered and irregular thin streaks of coal were observed in the rock. Another well on the east side of the south-east quarter of section 20 is likewise eighty feet deep, and penetrates the same strata. Another one, on a low prairie hill, near the middle of the west line of section 22, showed some shale fifteen feet below the surface, and then sandstones to a depth of ninety feet; while in other wells in the same section and vicinity, water is obtained at no great depth, and before any rock is struck. A branch of Mud creek which heads in this vicinity, in the west part of section 28, and runs through section 29, presents nearly continuous outcrops of sandstone from its head for a considerable distance downward. The rock is mostly rather soft, and in its upper part I noticed only a single thin intercalation of shales. At the foot of the breaks, whence the branch has much less fall, the rock was strongly cemented, somewhat calcareous, and even splintery in fracture, and there were some streaks of black carbonaceous slate, which may contain a little coal. I also noticed some large tumbling slabs of limestone of the Coal Measure formation, which evidently forms an intercalation in the sandstones, being, perhaps, substituted at some points for the calcareous layer of sand rock. Continuing along the branch, in the south part of section 29, I observed a considerable layer of a calcareous pudding-stone, consisting of concretionary masses of limestone, disseminated more or less in a sandy matrix, a combination of sand and lime in one stratum. This rock also occurs on Swanwick creek, in the north-west part of Perry county, and also in the shaft at Summerfield, in St. Clair county, in this same division of the Coal Measures. Underneath it, followed some argillaceous slate, and then a few inches of slaty coal.

At the Mud creek bridge, on the Sparta road, a mile further south, in the south part of section 32, we find, at the foot of the hill, a considerable thickness of gray argillaceous and arenaceous shales, with concretions of carbonate of iron; above them a black streak, apparently the rotten outcrop of a carbonaceous shale or slate, and then some large slabs of limestone; the whole undoubtedly corresponding to the exposure described above. A short distance down the creek, near the middle of the west half of section 32, I observed a heavy ledge of sandstone about twenty-five feet above the water. It was underlaid with a thin layer of the calcareous pudding-stone, then thin streaks of carbonaceous matter, and finally shales which reached to the water. For some little distance along the creek, we observed similar outcrops, with a varying thickness of the single layers. Another bluff of this formation, on the south side of the creek, in the north-east corner of section 31, shows eighteen inches of arenaceous material, irregularly penetrated by streaks of coal in oblique and curved lines, intercalated between beds of solid sandstone. Close by, there appeared two or three inches of coal, covered with a little slate, seemingly lower down than the lowest of these two beds of sandstone, and, only a few yards distant, arenaceous shales from the bank of the creek, occupying the place of the lower sandstone.

From the foregoing remarks, we see that this part of the formation is quite variable in its details, because the above sections evidently present repetitions of the same strata. It consists, where regularly developed, of some shales, a little stone-coal and slate, and a thin bed of limestone intercalated between sandstones. Locally, however, sand appears to have been deposited contemporaneously with the limestone, when, instead of a pure limestone, the pudding-stone or concretionary arenaceous limestone was produced, or even a hard calcareous sand-rock.. At other points, the irregularity was even greater. There is no doubt in my mind that this is the continuation of the limestone and thin seam of coal which occurs on the north side of Grand Coti prairie, in Perry county, of the pudding-stone on Swanwick creek, and perhaps even of the streaks of coal in the sandstone on the upper Beaucoup, in Perry county; also of similar formations in the Summerfield shaft, in St. Clair county.

The higher sandstones which form the ridge toward Elkhorn prairie continue north-eastward along the prairie. They are considerably exposed near the head of a branch of Mud creek, a short distance south-west of Elkton, in the north-west quarter of section 8, and the south-east quarter of section 7 (?), township 3, range 4. In the prairie at Elkton, they have been struck in wells at a depth of twenty feet, and penetrated forty feet without showing any intercalations of other rocks. At other points, they reach even nearer to the surface. At higher points, shales are said to be found next to the surface, as in the east part of section 9, and in section 16, and in a well a mile west of Elkton, in the south-east quarter of section 6. Farther west, in a well, also on high ground, on the south side of the prairie near the center of section 1, township 3, range 5, the sandstones were again struck at a depth of twenty-two feet. Thence north-westward, no rocks have been found through the whole extent of Elkhorn prairie, except at some points on its north-eastern margin, toward Elkhorn creek.

At Venede, which is situated at the edge of the lower part of the prairie, near Elkhorn creek, in the north-west quarter of the south-west quarter of section 34, township 1, range 5, a well, dug on low ground, passed through fifty feet of quaternary deposits, and twenty feet of shales, the lower portion of which was quite hard. Several wells in the west part of section 33, also on low ground, are said to have penetrated a layer of limestone from eight to twenty feet below the surface. The stratum referred to is undoubtedly far above the Belleville coal, and may be a local intercalation in the lower part of this sandstone formation. Perhaps it corresponds to the limestone described above on Mud creek; or it may even be another hard rock mistaken for limestone. On Elkhorn creek, for some miles above and below Venede, we find no rocky outcrops whatever, only a few high banks of quaternary clay, sand, gravel, etc., while the bed of the creek is generally muddy.

Three miles south-east of Venede, in the south-west quarter of section 11, township 2, range 5, shales were once more struck in a well, and in the north-west quarter of the north-east quarter of section 14, soft shaly sandstones were found. In the slope at the edge of the creek bottom, on the line between sections 11 and 14, highly arenaceous shales are laid bare in the road. This appears to be the first outcrop of the arenaceous portion of formation 4, which extends thence to the head of Elkhorn creek, forming the continuation of the strata described on Mud creek. In the south-east part of section 14, slaty shales were struck in wells in the edge of the timber; and at the edge of the prairie, a little east of St. Peter's Church, or Stone church, which is situated on the north-west quarter of section 23, they were again found ten feet below the surface, and penetrated several feet. Further south-east, Mr. BORCHELT dug a well on the north-east quarter of section 23, at the edge of the timber, considerably below the summit of the prairie. He also passed through the shales, and struck a ledge of hard sand-rock at twenty-two feet, and underneath it a thin seam of coal. On the small branch in the south part of the adjoining section (24), I observed various outcrops of the arenaceous shales, and blue slaty shales, and, higher up the branch, in the north part of section 25, sandstones, which evidently alternate with the shales. The sandstone has been considerably quarried in this vicinity. It resembles that in the south-west corner of the county, and is mostly light-colored, yellowish, greenish, or brownish, rather soft, of a rather fine grain, dresses well, and breaks in slabs of suitable thickness. At the head of a ravine, in the north-west quarter of section 25, at a higher level than the quarry, I noticed hard, thinly and irregularly stratified sandstones, underlaid with some feet of shaly sandstones, and then a little slate and some stone-coal, which would seem not to exceed a few inches in thickness. A boring made lower down the branch was carried about eighty feet deep, passing mostly through shales. In the north-east corner of section 26, Mr. MEIER also found arenaceous shaly strata in his well.

East of this point, on Elkhorn creek, the sandstones are extensively exposed, and the first outcrop above its mouth was found in the north-west quarter of section 19, township 2, range 4. The next one, similar to the first, is nearly opposite the mouth of Williams' fork, in the south-east part of section 19. Then, in the north-west quarter of section 29, some hard and thinly-stratified sandstone crops out at the water's edge. In the south-west part of section 29?, the sandstone forms a bluff bank nearly twenty feet high, and is mostly soft and massive in structure, with some harder ferruginous portions; generally, however, the banks of the creek consist of Quaternary clays, forming at some points high banks, strewn with drift pebbles and some rolled fragments of a hard Coal Measure limestone. The sandstone continues up the creek, and crops out at intervals in the south-east quarter of section 33, township 2, range 4, and in the east part of section 4, township 3, range 4. It forms the whole ridge toward Elkton, in the breaks of which it is exposed to a considerable thickness, without any intercalation of other strata. Through section 10, it forms numerous cliffs along the creek, some of which are twenty feet high. At the forks of Elkhorn creek, in section 11, higher strata appear to replace it. The rocks there are micaceous and arenaceous shales, with single harder layers of sandstone between them. They crop out occasionally to the middle of the west half of section 14, where I observed above them a layer of hard, firmly-cemented, calcareous sandstone, which is splintery in fracture, about sixteen inches thick, splits evenly, and contains numerous traces of coal plants. It is generally called bastard limestone in this vicinity, and is extensively quarried. Above it, I find some inches of soft blue slate, which has frequently been mistaken for a rotten coal, and then more sandstones of a rather massive texture, which continue to the head of the breaks in the north-west quarter of section 23, and in the south-east quarter of section 15. On the other branch of the creek, in sections 11 and 12, I also observed the shaly strata, and on the east side of section 12, at the edge of the prairie, much hard, thinly-stratified sand-rock. I am informed that the blue calcareous rock and the black slate have also been found in the breaks of this branch.

East of the main creek, in the midst of a little elevated post-oak flat, is the Little prairie. At its south side, in the north-east quarter of section 34, township 2, range 4, a well has been dug twenty-eight feet, through Quaternary deposits, and then twenty-four feet into alternations of sandstones and arenaceous shales, the last six feet being solid sandstones. In the banks of Williams' creek, a fork of Elkhorn creek, north-east of that prairie, the sandstones crop out in the south part of section 22, and in the middle of section 26. In the north-west quarter of section 26, much tumbling, rounded limestone is strewn in the bank, the same which had been observed, together with the drift-boulders, on Elkhorn creek; but no further outcrops were found on the creek, neither lower down nor higher up, except, perhaps, toward its head, near Grand prairie. On the northern fork of Williams' creek, not a single outcrop occurs; but, close to it, near the middle of the south half of section 14, the sandstone is in place at the bottom of a well.

Farther north-west, in the south-east quarter of section 10, township 2, range 4, in the timber, at the edge of Grand prairie, hard rock is in place at the bottom of a well, twenty-two feet below the surface. From the account which I received, it seems to be hard sandstone. A mile and three-quarters farther west, in the south-east corner of section 8, also at the southern edge of Grand prairie, some hard, strongly-cemented sandstone forms the bottom of a well; and, two miles north from there, at the edge of the timber near a branch of Elkhorn creek, in the south-east quarter of section 32, township 1, range 4, and a quarter farther south, in section 5, township 2, such sandstones have been struck and penetrated a few feet in shallow wells. Again, three miles farther north-west, in the post-oak flats, between the prairie and Okaw river, in the north-west quarter of section 24, township 1, range 5, the sandstone was struck at a depth of twenty-two feet. These are the only traces of the sandstone formation, which was so prominently developed and exposed on the upper course of Elkhorn and Mud creeks. They are, however, sufficient to prove that this western arm of Grand prairie is underlaid with this sandstone formation, underneath the covering of Quaternary deposits, in which the water is generally obtained, and below which the wells do not penetrate.

Near Plum creek, this sandstone formation crops out, and has been quarried on a branch close to the creek, south of the center of section 21, township 1, range 4. It is little exposed and is partly shaly, partly firm; some of it is ripple-marked. At Bridgeport, which is situated in the north-west corner of section 21, it has been struck at a depth of twenty-one feet, in digging near the creek; but on higher ground shales were found at a depth of about twenty feet, over twelve feet thick. These undoubtedly form an intercalation in the sandstone formation. On some hills east of the creek, in the center and on the north-east quarter of section 22, shaly sandstones have been found in several wells. East from there, no rocks have been discovered for several miles; but the next outcrops which we find, in that direction, are formed by a higher formation.

At the Stone-coal Ford of the Okaw, in the south-east quarter of section 1, township 1, range 4, is the only outcrop of rock on that river so far as it forms the boundary of Washington county. The lower part of the bank and the bed of the river consist of gray and greenish argillaceous shales. Next higher, follows a seam of coal, capped with black slates, which are only exposed when the water is not very high; and then, high banks of Quaternary clay, etc., which form abrupt but not very high hills. The coal and slate are together about eighteen inches thick; the coal, from ten to twelve inches. Besides drift gravel, I noticed tumbling pieces of a brown, highly-fossiliferous limestone, which closely resembles No. 9 of the Nashville section; and, especially a short distance above the ford, numerous large masses of a limestone closely resembling the Shoal-creek limestone. The latter were so numerous that I was forced to the conclusion that this rock must underlie the upper part of the adjoining hills, and that the foot of the hills at the ford was formed of the underlying slates and shales. This conclusion was still further substantiated by finding large blocks of the Shoal-creek limestone near the head of the little branch which empties just above the ford, near the middle of the east line of section 12, and lower down on the branch. About two and a half miles farther east, toward Little Crooked creek, it was found in place.

Southward, the prairie rises considerably, and forms a prominent ridge of hills, which extend from the head of Plum creek toward Nashville and the main dividing ridge. The first of these hills is Plum hill, in the middle of section 3, township 2, range 4. In a well there, black slates were struck, and a little limestone, undoubtedly the lower part of No. 3 of the county section. By digging a few feet deeper, probably the same thin seam of coal would have been found which crops out at the Stone-coal Ford, on the Okaw river. In other wells near by, shales were struck, probably those underneath the black slate and coal. While the wells here do not generally reach down to the rocks, slaty shales were struck at the south side of the prairie, in the north-west quarter of section 14, and in the prairie in the north-west quarter of section 12; the latter belonging apparently between the black slates and the Shoal-creek limestone, which is found in wells soon after crossing the range line, in section 7, township 2, range 3.

Farther south-east, I could not distinguish the minor subdivisions below the Shoal-creek limestone, and finally, owing to imperfect exposure of the strata, I lost even the division line between them and the main sandstone formation, or Nos. 3 and 4 of the county section. Shales overlying the lower sandstones, besides at the above-mentioned points, were struck in wells on the east side of a small prairie near the east line of section 24, township 2, range 4, and on the slope near the head of William's creek, in the north-west quarter of section 30, township 2, range 3. In the creek at this point, so large a quantity of limestone is strewn that one might be disposed to conclude that there was a layer of limestone in place near by; but the rock is associated with Drift boulders, and most probably originates from the Shoal-creek limestone, on the higher ridge. The above-mentioned shales were also found in wells farther south in the prairie; at the meeting-house near the west line of section 31; also in the north-east quarter of section 31, township 2, range 3; and, I believe, in section 6, township 3, range 3. In a well near the north-west corner of section 33, rock has also been struck at a depth of twenty-five feet, and has been penetrated several feet. A little south of east from there is a high prairie hill, near the head of Locust branch, hardly lower than the main dividing ridge. On this hill, in the west part of section 34, township 2, range 3, Mr. EADS dug a well one hundred feet deep, and, getting no water, he bored nearly as much deeper after coal. I could not obtain a satisfactory account of this work. I only ascertained that the Shoal-creek limestone did not reach that far, but that the formations passed in the well are all lower than that limestone, consisting mostly of shales and sandstones. It is doubtful whether the black slates and coal No. 3, of the general section, were found. A thin streak of coal was drilled through, at a depth of at least one hundred and fifty feet, corresponding apparently to No. 14 of the Nashville section, in the lower sandstone. Farther south in the prairie, part of the wells strike rocks: one near the middle of the east line of section 5, township 3, range 3, struck sandstone at twenty-three feet, and penetrated it ten feet. Another one, just a mile farther south, penetrated it fifteen feet. Another one, in section 17, twenty-eight feet deep, struck shales. In the north-east quarter of section 19, and the north-west quarter of section 20, shales and a hard rock, probably a somewhat calcareous sandstone, were reached. All these strata are lower than the Shoal-creek rock, and include, perhaps, the upper part of the lower sandstone. Similar strata have been discovered in wells near the southern edge of the prairie, in the south-east quarter of section 27, township 3, range 4; in the south-east quarter of section 24 of the same township; and at the Pilot Knob, in the north-east quarter of section 30 (?), township 3, range 3. At the eastern edge of the prairie, a well was dug near the center of section 27, township 3, range 3, sixteen feet through surface deposits, and then forty-five feet in solid sandstone. Another, not far from the center of section 22, is seventy-five feet deep, mostly in sandstone, with some shales above it; and a great thickness of sandstones was also found in a well farther north, near the center of section 15.

In the barrens west of Locust branch, this sandstone formation continues, cropping out in section 23, and on a small branch north of Three-mile prairie, in the east part of section 26, and in section 25, township 3, range 3. In Three-mile prairie, the sandstone is exposed on a ravine in the middle of the west half of section 36. At the west side of the prairie, in the west part of section 35, a well has been dug seventy feet deep, nearly altogether through solid sandstone. At a depth of forty feet, some irregular streaks of coal were found in the rock, but no well-defined vein. This, together with the blue, hard, calcareous sandstone which is exposed on a branch in the east part of section 1, township 4, range 3, a short distance south of the county line, reminds me strongly of a similar formation near the south end of Elk prairie, and on Mud creek, of which this forms apparently the continuation. The sandstone is also exposed, at the south side of the prairie, on ravines in the south-west quarter of section 36, township 3, range 3, and near the south-west corner of section 31, township 3, range 2.

On Locust branch, strange to say, the sandstones do not outcrop, nor in the hills between it and the Beaucoup, although they are undoubtedly underlaid with this formation. At the head of Locust branch, I noticed loose fragments of sandstone, but they originate from higher layers. In the north-west quarter of section 2 (?), township 3, range 3, I observed in the bank pieces of a brown, highly fossiliferous limestone, apparently from the same layer which has been struck at Nashville, in connection with the black slate, No. 3 of the county section. It would therefore seem as if this stratum passed through the hills above this point. In the south-west quarter of section 13, and in the north part of section 24, some distance above the mouth of Watering branch, we find much loose sandstone in the banks, together with Drift boulders; and thence down to the county line, high clay banks, with boulders, are to be seen, now and then, but no strata in place. On the branch, the sandstone crops out at several points of its lower course, and on some of the ravines, in the adjoining barrens, especially in the south-west quarter of section 8, and in section 18, township 3, range 2. Three-quarters of a mile above its mouth, in the north-west quarter of section 19 (?), a streak of coal, from one to two inches thick, is said to have been noticed in the rock. Higher up the branch, in the south-west quarter of section 5 (?), a man once dug eight feet down in the bank of the creek, and is reported to have found six inches of coal. I noticed fragments of shale and slate which he had thrown out. As large masses of the Shoal-creek limestone are found near by, I have little doubt but that this was the small seam of coal which is generally found a short distance below this limestone formation—No. 11, of the Nashville shaft. A little lower down, in the north-west corner of section 8 (?), shales, with concretions of carbonate of iron, were dug up close to the creek, evidently from nearly the same geological horizon.

On Beaucoup creek, the strata below the Shoal-creek limestone first reach the surface in the north-east quarter of section 27, township 2, range 2, and from there extend southward along the creek for about two miles, while the limestones still continue in the hills. At that point, in section 27, twelve feet of shaly sandstones are exposed at the water's edge, and the limestone is in place only a few feet higher up. The shaly strata are then found at numerous points down the creek, in the south part of section 26, and the north part of section 35. In the east bank of the creek, in the south-west quarter of section 35, I observed, above some gray shales, a seam of coal eight inches thick, capped with some slate, and, close by, more of the arenaceous shales were exposed. The coal crops out with the same thickness, a short distance farther east, on a branch of the Beaucoup, on the south line of the same quarter of section 35; and Mr. PATTERSON, in boring fifty feet deep, at a quarry of the

Shoal-creek limestone, in the hills farther south-west, in the north-east quarter of section 3, township 3, range 2, passed through black slate and shales, underneath the limestone, and, at a depth of twenty-five feet, struck three feet of black slate, with some inches of coal. The coal, at all these points, is unmistakably No. 11 of the Nashville section.

Lower down on the Beaucoup, gray shales, with thin intercalations of sandstone and concretions of iron ore, and some black slates, were found exposed in the south-west quarter of section 2, or the south-east quarter of section 3, township 3, range 2; then, near the middle of the north half of section 10, a bluff of sandstone, thirty feet high, is seen, where the rock is partly shaly, partly firm enough to be quarried for building stone. Shaly arenaceous strata crop out in the bank of the creek for some distance above, and also below the mouth of Sugar creek, in section 15; but the next outcrop on the creek occurs several miles farther south, close to the county line, and also consists of sandstones. Panther creek also exhibits no rocks on its lower course; but, far up in the barrens, I observed some shales in the east part of section 24, and the sandstones reach the surface in the barrens, in the north part of section 23, and at other points, also in the timber on the north-west side of Mud prairie, near the middle of the west line of section 36, toward the center of section 25, township 3, range 2, and in the south-west quarter of section 30, township 3, range 1. At the edge of the prairie, near the south line of section 30, shales have been struck in wells.

At and near Coloma, on the eastern edge of Mud prairie, the sandstones crop out in several ravines in the north part of section 33, township 3, range 1. Little Muddy river is only three-fourths of a mile east of the station. The barrens east of the creek are evidently underlaid with the sandstone formation, although no outcrops are found in the south-eastern corner of the county, except on the Little Muddy itself. These sandstones, partly in thin layers, partly in heavy beds, are found at several points from the county line northward, in sections 34 and 27. Much sandstone has been quarried near the middle of the west line of section 27, and in the north-east quarter of section 28, especially for building the railroad bridge, a mile farther north. It forms heavy layers, and works well, but is mostly rather soft. It is of fine grain, light-grayish or yellowish-gray colors, mostly full of minute brown ferruginous spots, and small scales of silvery mica. Some portions of the rock are bluish-gray, and very hard. It is interstratified with arenaceous shaly layers. In the south-west quarter of section 22, sandstone forms the bed of the stream; but, a few rods farther north, the bank is formed of black laminated slates, with a thin intercalated ledge of dark-colored slaty and highly fossiliferous limestone. A little farther up, at the railroad bridge near the west line of section 22, the bank, about twenty-five feet high, consists of bluish-gray slaty shales. Some distance above the bridge, I observed, in a similar bank, about fifteen inches of dark-colored slate, containing two thin seams of coal, each from one to one and a half inches thick. A little higher up the creek, in the north-east quarter of section 21, the shale dips gradually to the northward, and a heavy ledge of limestone, underlaid with some black slate, is seen in place above it, and soon reaches the level of the creek. Half a mile to the westward, in the north part of section 21, the coal is again exposed on a branch, a short distance below the same limestone, forming here also a regular seam of eight inches of good coal. Farther north, the limestone rises again, in consequence of an undulation of the strata, but I am not satisfied whether the lower strata reach the surface in that direction.

*The Shoal-creek Limestone.*—This limestone, which overlies the formation described in the foregoing pages, is a light-bluish-gray or yellowish-gray limestone, with subconchoidal fracture and subcrystalline texture, hard, and somewhat silicious or argillaceous. It occurs partly in beds eighteen inches or more in thickness, partly in thin ledges from two to four inches thick, with either an even or uneven surface. Its aggregate thickness varies between four and ten feet, and is generally about seven feet. It works well as an ordinary building rock, is of great value for foundation walls, and can be burned to a dark-colored but strong lime. Of fossils, it contains the following species: *Productus longispinus*, *Chonetes mesoloba*, *Retzia punctulifera;* also, *Productus costatus*, ? *P. Prattenanus*, *Spirifer cameratus*, *S. planoconvexus*, *S. Kentuckensis*, *Athyris*, *Hemipronites*, *Rhynchonella*, *Nautilus*, etc. In shales and slates closely allied to it, we observed, besides these, at least five species of *Bellerophon*, three species of *Macrocheilus*, several species of *Pleurotomaria*, *Euomphalus*, *Nucula*, *Orthoceras*, etc.

We find this limestone at various points in a zone extending from north-west to south-east through the middle of the county, overlying the above described rock, which crops out south-west of it; and it is succeeded by higher beds toward the north-east. It thus furnishes evident proof of the general north-eastern dip of the strata in this county; but the relative position of its outcrop shows most conclusively that the dip is not quite regular in one direction, but somewhat undulating. Thus, Little Crooked creek runs in a depression of the strata, while the rocks rise east and west of it; and we shall point out other irregularities of this kind in the course of the description of the single outcrops. The same feature is very prominently developed in connection with the same formation in Clinton county.

I have already stated that large masses of the Shoal-creek limestone were found tumbling in the bank of Kaskaskia river, just above the Stone-coal Ford, not far from the line between ranges 3 and 4, and also at the head of a little creek about a mile south from there; so that it seemed as though the rock must be in place in the upper part of the hills. It was, however, first found actually in place over two miles farther east, in some wells in the prairie, near the center of section 16, in the north-west quarter of section 16, township 1, range 3, and on the east side of section 9, at depths from sixteen to twenty-four feet; and it crops out close by, on a ravine just below the level of the prairie, at Mr. HOLMES', in the north-east quarter of section 16. The upper layers, which are here alone exposed, are each from three to four inches thick; the lower ones appear to be heavier, and the rock is fine for building purposes. A mile farther east, the limestone forms the bank of Little Crooked creek, in the north-east quarter of section 15, and is between seven and eight feet thick. It here contains a small cave, with a spring which undoubtedly drains some sink-holes west from there in the low hills, and is noted in the early history of the country for an Indian massacre. The limestone is also exposed a mile farther north-east, on a ravine a short distance west of the creek, in the north-east quarter of section 11, and two miles east of Little Crooked creek, on a ravine in the prairie near the Lutheran church, and in the south-west quarter of section 18, township 1, range 2, considerably above the level of the creek. At the latter point, the limestone is of grayish color, and apparently over six feet thick. The church, a stately edifice, has been built of it. In digging a well at the church, the limestone was struck at a depth of eighteen feet, three feet thick; the upper layers of it had probably disintegrated. Then, several feet of black slate were found, which generally follows underneath the limestone, and occasionally contains faint streaks of coal, but here it was surrounded by arenaceous, shaly strata. The wells in this part of the prairie are generally shallow, and the water is obtained from the surface deposits; but, south-west of the church, toward the edge of the prairie, in the west part of section 24, and in section 23, township 1, range 3, black slates are said to have been struck in the wells at several points, which are apparently those underlying the limestone. Farther north-east, in the north-west quarter of section 5, township 1, range 2, the limestone is said also to have been struck in somewhat deeper wells, but I could not obtain satisfactory information in relation to it. On Crooked creek, in the north part of section 28, township 1 north, range 2, I noticed at the foot of high banks of yellow clay, drift-boulders, with pieces of sandstone, and some large blocks of limestone similar to the Shoal-creek rock; and it is said that, a short distance higher up the creek, its bed consists of solid rock, (which could not be seen at the time of my visit), supposed to be limestone. It would therefore seem as if the Shoal-creek limestone did outcrop thus far east; still, I am not positive about it. A mile farther east, higher sandstones were found.

Turning southward again, we find no exposure of the limestone for a considerable distance. It is said to form the bed of Little Crooked creek, near the forks of the Middle and Nashville branches, in the north-west quarter of section 35, township 1, range 3, and that of Middle branch east of the center of section 6, township 2, range 2; but the higher sandstone formation occupies the uplands north and south from there, and the next point, where it is more prominently exposed, is at the head of Rock branch, a tributary of Middle branch, just below the edge of the prairie which forms the main dividing ridge, in the center and north-west part of the north-west quarter of section 9, township 2, range 2, where it has been extensively quarried. There the limestone is seven feet thick, in ledges from three to eighteen inches thick, and rests upon three feet of black laminated slate, which contains a little coal. It crops out once more a mile farther east, in the north-west quarter of section 10, in a similar position; but then the higher sandstones succeed, which are also found north and south of the two last named points. The dip of the limestone from Rock branch to Little Crooked creek is therefore to the north-west; but from the former point it changes again to the north-east.

The most westerly point where the Shoal creek limestone has been observed in this county is on the high ridge, six miles north-west of Nashville, in the west part of section 7, township 2, range 3. There, limestone and sandstone are reported to have been struck in several wells, which, to all appearance, must be the Shoal creek limestone, and a sandstone close above or below it. A mile farther east, near the north-east corner of section 18, this limestone was again struck, on the summit of the ridge, at a depth of thirty or thirty-five feet, while, in another well close by, a sandstone was found at twenty feet, which seems to overlie the limestone. On the same ridge, near the middle of the south half of section 17, the limestone is thirty-five feet under ground, covered with twenty feet of shales. Close by, on lower ground, in the south-east quarter of section 17, a shaft was sunk in 1857, to the depth of eighty-six feet, in the unwarranted expectation of finding a heavy layer of coal at a small depth. The Shoal-creek limestone in this shaft was seven feet thick. Above it there was shale; below it, black slate; then, shales and sandstone. Nine inches of coal was found at a depth of eighty-two feet, most likely the same seam which crops out at the Stone-coal Ford. North of these points no rocks are exposed for several miles, but the limestone probably continues uninterruptedly to Crooked creek. South-westward the ridge falls off rapidly, and the limestone can not extend much farther in that direction.

The only outcrop of the limestone in this vicinity is at the head of Willow branch, near the summit of the dividing ridge, at Mr. Balderson's, near the south-east corner of section 20, where it is quarried extensively; and also on the south-west quarter of section 21. It is there about eight and a half feet thick. The upper two feet consist of thin plates of limestone, mixed with shale; the lower six feet form heavy layers. Below it follow a few inches of shale; then three and a half feet of black laminated shale, and then sandy shales more or less slaty.

A mile and a quarter farther east, in the south-west quarter of section 22, and in the north-west quarter of section 27, the limestone has also been struck in several shallow wells, on the high ridge; but thence it seems to dip strongly to the north-east. Near the south-east corner of section 15 it has been found in a well on much lower ground, and at Nashville it lies at a considerable depth.

Nashville is situated in the north-east part of section 24, township 2, range 3, near a branch of Little Crooked creek, on the northern slope of the ridge. I will not now speak of the uppermost formations there which overlie the Shoal-creek limestone, but I will give the section of the shaft which was sunk by Mr. HUEGELI, near his flouring mill, on the lowest upland adjoining the creek bottom. The shaft was sunk two hundred and thirty feet deep, and then two hundred feet more were drilled down. The work was stopped in 1862. The following is a closely approximate section, for which I am indebted to the courtesy of Mr. HUEGELI:

*Section of Strata in Mr. Huegeli's Shaft, at Nashville, on the south-west quarter of the south-east quarter of Section* 13, *Township* 2 *south, Range* 3 *west.*

| No. | | | |
|---|---|---|---|
| 1. | Soil and drift-clay | 11 | feet. |
| 2. | Shale | 4 | " |
| 3. | Arenaceous limestone | 3 | " |
| 4. | Sandstone and shales | 62 | " |
| 5. | Hard blue limestone—Shoal-creek limestone | 7. | " |
| 6. | Black laminated slate, with streaks of coal | 3½ | " |
| 7. | Sandstone | 13 | " |
| 8. | Clay shale | 15½ | " |
| 9. | Gray and brown fossiliferous limestone | 1 | " |
| 10. | Black shales, with fossils | 9 | " |
| 11. | Coal, 14 inches | 1⅙ | " |
| 12. | Sandstones and shales | 70 | " |
| 13. | Limestone (areno-calcareous conglomerate?) | 7 | " |
| 14. | Coal, 8 to 10 inches | 0¾ | " |
| 15. | Shales | 22 | " |
| | Bottom of shaft | 230 | feet. |

Below this a boring was carried down two hundred feet from the bottom of the shaft; one hundred and seventy feet reported to be shale, and the lower thirty feet alternations of limestone and shale, probably the beds overlying the DuQuoin coal.

At various depths concretions of carbonate of iron (kidney ore) were found in the shales. It is a great pity that the work was abandoned at this point, when very little more work would have settled the question whether the Du Quoin coal extends that far, and with what thickness, for the boring must nearly have reached the base of the limestone above the coal. The shaft is only covered, not filled, and the drill-hole is probably still open, at least part of the depth. The work could probably be resumed at a small cost, and the boring ought to be carried deeper by all means. By boring from twenty to fifty feet deeper, the chances of obtaining coal at this point, from the Du Quoin seam, would be positively settled.

At the south side of the dividing ridge, the Shoal-creek limestone was next discovered at the head of Watering branch, in a ravine near the edge of the prairie, in the middle of the east half of section 31, township 2, range 2. Farther down the branch, still in the south-east corner of section 31, large tumbling masses of it were observed, which seem to be very little moved from their original position, and they are associated with blocks of a calcareous sandrock, full of fossils, which seems to correspond to the Joliff's mill-rock. If the latter rock is in place in the upper part of the hills in this vicinity, it would seem as if the limestone had a local dip to the southward, and, indeed, about a mile lower down, at a sharp bend of the creek, near the north-west corner of section 8 (?), township 3, range 2, large blocks of the limestone were once more observed in the bank, fully four feet thick. The branch valley is there only a few yards wide, and has apparently been hemmed in by the limestone which thus seems to be in place a few feet above the water-level. The lower sandstone formation begins to crop out some distance farther south.

On Beaucoup creek, the Shoal-creek limestone is first exposed at the water's edge, on the north-east corner of section 27, township 2, range 2. It probably reaches a short distance higher up the creek. Down the creek, it continues in the hillsides, gradually rising above the water level, and crops out on the west side of the creek, at numerous points in sections 27 and 34, and in the north-east quarter of section 3, township 3, range 2. It has also been struck in various wells at the eastern edge of the prairie in section 34, and in the south-west corner of section 27, at a depth of twenty-two feet. The limestone here is partly blue, partly grayish, and on the outside, frequently brown. It is at least seven, and probably ten feet thick, and rests on black laminated slates and arenaceous shales.

We find it next, several miles farther south-east, in the barrens near the Little Muddy, near the middle of the north line of section 17, township 3, range 1, and at several points in or near the south-west quarter of section 9. It is here over eight feet thick, is underlaid with black slate, and dips eastward, toward the Little Muddy. In a well on the ridge near by, only three-eighths of a mile from the creek, the sandstone which overlies the limestone, has been struck at a depth of only six feet, and in a ravine close by, some eighteen feet of it is exposed in one bluff. The sandstones and shales higher up on Little Muddy, especially in section 4, evidently belong to the higher formations, and the limestone seems first to strike the creek in section 9, but is exposed only in its banks south-east of the center of section 16, where it begins a few inches above the water level, and forms a low bluff. It holds a similar position a few rods farther east, but then it is seen rising southward and westward. Near the south line of section 16, it caps a low bluff on the creek; and, still lower down, above the railroad bridge, it is only found in tumbling masses at the foot of high exposures of lower strata, while on a ravine west of the creek, in the north-west quarter of section 21, it has once more been observed in the barrens. East of Little Muddy, limestone is said to have been discovered, in digging a well, twenty-two feet below the surface, in the timber on a branch of Little Muddy, considerably below the level of the prairie, in the north-east quarter of section 11, township 3, range 1; but this may have been a higher ledge of hard sand-rock. Three-quarters of a mile north of Richview, it has also been struck in sinking a shaft close to the Illinois Central railroad, near the north line of section 2, township 2, range 1, at the edge of the high prairie. Judge PHILLIPS, of Richview, to whom I am indebted for the information in relation to this undertaking, states that the limestone was found at a depth of about one hundred and twenty feet, from six to eight feet thick. Then followed downward, below the limestone:

| | | | |
|---|---|---|---|
| Black slate | 3 | feet. | |
| Fire-clay, (argillaceous shales) | 8 | " | |
| Stone-coal | | " | 4 inches. |
| Fire-clay, (shales) | 4 | " | |
| Sandstone | 31 | " | |
| Slaty rock | 7 | " | |
| Black slate | 2½ | " | |
| Shale | 8 | " | |

No exact data could be obtained for the rest of the work. The shaft was sunk to a depth of two hundred feet, and then they bored sixty feet deeper; but no journal was kept of the strata penetrated.

*The Upper Sandstone Formation.*—The most westerly point, where any strata were observed above the Shoal-creek limestone, was at the trial-pit on the ridge some miles east of Nashville, in section 17, township 2, range 3, and in some wells north-west of it. They consisted of sandstone and shales, the latter apparently arenaceous, and were not more than about twenty feet thick.

Near Nashville, we find this formation much more largely developed. In the shaft at the lower end of the town, sixty-nine feet of this formation were passed through, and it forms part of the high hills north of town. In the shaft, we find next above the limestone, sixty-two feet of shales, sandy shales, and shaly sandstones, and then three feet of a "bastard limestone," and four feet of shales underneath eleven feet of soil and clay. The bastard limestone was a hard rock, apparently a mixture of sand and lime, and I am strongly inclined to the opinion that it corresponds to the Joliff's mill-rock, on Crooked creek, mentioned below. On Little Crooked creek, a short distance south-east of the shaft, near the south line of section 13, the bank consists of about fifteen feet of soft sandstone, which contains some thin irregular streaks of stone-coal, varying in thickness from that of a knife-blade to over four inches. This sandstone has been struck in several wells in the east part of the town, south-east of the shaft, and also in one a short distance south-west of the shaft, where it reached from ten to twenty feet below the surface; and it is therefore very strange that no trace of it has been found in the shaft. In the western part of the town, which is higher, shales are struck in digging wells, and water is not so readily obtained. Shelly sandstones and shales are exposed in a ravine on the hills south of Nashville, which form the dividing ridge, near the middle of the north line of section 25, township 2, range 3; and in a well on a high point in the south-east corner of section 25, shaly strata were struck; these latter may, however, be really lower strata of this series, which have risen to this altitude in consequence of the inclined condition of the strata.

From Nashville eastward, this sandstone formation extends over the dividing ridge, and thence northward, over the uplands, to Crooked creek. The wells on the ridge generally do not reach down to rock; still, the sandstones have been found at sufficiently numerous points to trace their extent. They have been struck in wells at the western edge of the prairie, between the Nashville branch and Middle branch of Little Crooked creek, on rather low ground, in the north-east quarter of section 18, township 2, range 2, at a depth of only fourteen feet; and at the north-western extremity of this arm of the prairie, in the south part of section 1, township 2, range 3, at sixteen feet, where it is hard and bluish in color. Then it has been struck on the high prairie in section 16, township 2, range 2, and in the south-east quarter of section 10; also, farther south, at the edge of the prairie towards the Beaucoup, in the south-east quarter of section 15, in section 24, and as far as Col. Phillips', in the middle of the west half of section 27. There, in a ravine below the prairie, thinly-stratified shelly sandstones are exposed above the Shoal-creek limestone, and the sandstone crops out also a mile farther north, on a branch of Beaucoup creek, not far from the main stream, in the north-east quarter of section 22. It undoubtedly underlies the barrens between the head of Beaucoup and Little Muddy creeks, in the eastern part of which it has been quarried in section 30, township 2, range 1, and has been struck in a well in section 6, township 3, range 6. In the adjoining so-called "dry arm" of the prairie, I am informed it is difficult to obtain water, and sandstones have been struck quite shallow at its west side, near the south-west corner of section 29, township 2, range 1, and farther south, and also in the south-west quarter of section 28, and at other points. On the upper course of the Little Muddy, near Ashley, the sandstones still prevail, but no rocks are exposed on it higher up than the south-west quarter of section 34, township 2, range 1, and thence downward, at intervals, to the north part of section 9, township 3, range 1, the first outcrops consist of sandstones, the next, of bluish-gray argillaceous slate, and the lower outcrops, of arenaceous shale, with concretions of carbonate of iron.

Returning north-westward, we find that gray indurated shales were struck in a well at the edge of the high prairie, at the head of Middle branch of Little Crooked creek, in the south-east corner of section 1, township 2, range 2. Soft and partly shaly sandstones crop out on the branch in the south-east quarter of section 2, and in the north-east quarter of section 3, and are also found exposed in the barrens a mile and a half farther west, south of the branch, in the north-west quarter of section 4. North of Middle branch, near the north-east corner of section 6, the shaly sandstones were also struck at the edge of the prairie, and penetrated to a depth of thirty-two feet; this is the most westerly point where they have been discovered north of this creek. Sandstones were also found in wells in this part of Grand prairie, near the south line of section 35, township 1, range 2, in the north-west corner of section 35, in the south-west quarter of section 27, in the west side of section 21, in the south-east quarter of section 16, and at some other points. In most of these wells, water is, however, obtained either before striking the rock or after digging a few feet into it. Slaty rocks were discovered in other wells farther east, near the north-west corner of section 26, and in the south-west quarter of section 24, where a thin seam of coal is said to have been found between them, and west of Hoyleton, in the north-west quarter of section 14, where they rested on shaly sandstones. More sandstones were then struck farther east, in the high prairie, in the north-east quarter of section 30, township 1, range 1, from whence they seem to continue to the head of Grand-point creek, and in the middle of the east half of section 24, township 1, range 2, where a well was dug forty feet deep, mostly through soft shelly sandstone, without getting water. A mile and a half farther north-west, at Hoyleton, in the north-west quarter of section 13, sandstone and shaly rocks are struck at the bottom of wells which are seldom more than twenty feet deep. North of Hoyleton, the prairie is lower, and the first traces of this formation have been found in a well on the low hills near Crooked creek, at the northern edge of this prairie, on the east side of section 27, township 1 north, range 2, and farther east; they consisted of arenaceous shales or shaly sandstones.

The first conspicuous outcrop of rocks on Crooked Creek is in the north-east quarter of section 25 (?), township 1, range 2, at an old saw-mill, called Joliff's mill. The principal ledge there is a finely-grained, grayish-blue, calcareous sandstone or mudstone, with a brown surface. It is not uniform throughout. In some places it is more arenaceous—a hard sandstone; in others, more slaty. It is from two to two and a half feet thick, and contains numerous fossils, especially *Productus Prattenanus*, *Pinna per-acuta*, together with *Myalina*, *Spirifer*, and many others. It is underlaid with a few feet of arenaceous shaly strata. A quarter of a mile higher up the creek, the same strata crop out again. This calcareous sandstone does not appear to be exposed any where else in this county; but I have found tumbling fragments of rock, closely corresponding to it, with the Shoal-creek limestone at the head of Watering branch, and also on the upper course of Little Muddy river. I presume it is the same stratum which, in the section of the Nashville shaft, has been designated as No. 3—a "bastard limestone"—and is there sixty-two feet above the Shoal-creek limestone, forming an intercalation in the sandstones and shales of the Upper Coal Measures.

At the edge of the prairie which overlooks the Crooked creek bottom, half a mile south-east of the exposure described last, on the south-west quarter of section 30, township 1 north, range 1, sandstone and shales are struck in wells, and also south-east from there, in the prairie, in the south-east quarter of section 31, while most of the wells do not penetrate to the rocky substrata.

On the lower course of Grand-point creek, there is only one outcrop, three-fourths of a mile from its mouth, in the south part of the north-west quarter of section 29, township 1 north, range 1. It consists of shales, containing thin shells of hard sandstone. Then there are no more exposures on the creek, and only here and there a high bank of clay, with drift boulders and a few tumbling rocks, until we reach its upper branches. On these I observed some small outcrops of sandstones, at a few points, in the south-west quarter of section 28, the north-west quarter of section 27, and the south-west quarter of section 23, township 1 south, range 1, and in the east part of section 5, township 2, range 1. The rock is mostly thinly stratified and intercalated with shales. Such sandstones were also noticed near an eastern branch of the creek, on a ravine, in the north-west quarter of the north-east quarter of section 1, township 1, range 1, and on the west side of the Illinois Central Railroad, not far from the base line; while on the creek, half a mile farther north-west, in the south-west quarter of the adjoining section (36), loose slabs of a highly cemented, hard, blue, calcareous sandstone were observed. Near Irvington, in the south-west quarter of section 12, township 1, range 1, sandstone has been quarried on the high prairie. At Irvington, water is obtained in the Quaternary deposits; but on the lower ground, a mile farther west, shales have been struck at a depth of eighteen feet, and on the prairie hill, half a mile north-east of the station, a thin seam of stone-coal, said to have been twelve inches thick, has been penetrated in digging a well. This is probably the same coal which has been discovered at other points farther east, north-east and south-east, and which is intercalated in the upper sandstone formation.

On the high prairie ridge, south of the head of Grand-point creek and west of Richview, the sandstone has also been struck in several wells. At some points the water is obtained above any rock, and at others under a few feet of soft sandstone, which generally reaches to within ten feet of the surface. At still others the rock has been penetrated more than ten feet without getting water.

The old town of Richview lies on this ridge, round the center of section 10, and is underlaid with the sandstone, which crops out in the ravines in the north-east quarter of section 10. The station and new town are situated in the south-west quarter of section 2, township 2, range 1.

Shelly, soft rock and arenaceous shales crop out at various places in the branches above and below the town, in the south-east quarter of section 3, in the north part of section 11, and in section 12, on a branch of Big Muddy river, where the rocky bluffs are in places more than thirty feet high; also on smaller ravines farther south, in sections 11 and 14. In a ravine west of the town, I noticed at one point, together with drift boulders and tumbling sandstones, a large amount of fossiliferous limestone, similar to limestones which occur farther south-east, in connection with a thin coal-seam. It is, perhaps, in place in the hill, and, being a thin layer and partly soft, is not prominently exposed. The sandstones were also found exposed north-east of Richview, below the edge of the prairie, in a ravine in the north-west quarter of section 2, and has been struck in wells north-east of the center of section 36, township 1, range 1, and again half a mile farther north-west, just beyond the county line.

Ashley is situated at the edge of the prairie, on the north side of section 27, township 2, range 1, mostly in the north-east quarter of the section. Water is obtained at some points above the rocks, at a depth of from twelve to twenty feet; but usually the sandstones are struck in digging wells, and they crop out at several points some distance east and north-east of the town. At the edge of the prairie, south-east of Ashley, in the south-west quarter of section 26, and in section 35, the wells are generally a few feet deep in shelly sandstone, which has also been struck in the prairie in the south part of section 25, while on a higher hill, near the center of the north half of section 36, shales were found in a well. Half a mile east of the county line, in Jefferson county, I observed considerable outcrops on branches running eastward. At Mr. HUNTER'S, in the north-east quarter of section 7, township 3, range 1 east, a seam of stone-coal, from eight to twelve inches thick, was noticed just below the edge of the prairie. It is capped with arenaceous shales, and is also underlaid with two feet of the same, below which follow several feet of sandstone, and then arenaceous shales. The sandstones are of a fine grain, and firm, partly ripple-marked, and partly in smooth ledges, which form a very desirable building material, and are used as such at Ashley. Some traces of black slate were noticed with the coal. A short distance lower down the bank I noticed, intercalated in the shales, large slabs of fossiliferous limestone, perhaps the same of which I had seen indications near Richview. The coal is also exposed in other ravines farther south-east. The sandstones are also exposed in a ravine a mile farther north, in the north part of section 6, and the limestones and shales a short distance lower down. The heaviest slabs of the limestone measured eight inches, while I noticed much thinner shells of the rock in the shales. Two and a half miles farther north-west, and nearly east of Ashley, in the south-west quarter of section 24, township 2, range 1 west, I observed the same sandstone on a ravine in the edge of the timber, partly in fine ledges, partly shelly, and, lower down, shaly outcrops, and also, large, loose slabs of the above-mentioned limestone. Traces of the coal are said to have been found farther north-west, in section 23 or 14.

## *Economical Geology.*

*Coal.*—We have seen that the geological formation of Washington county is that of the upper part of the Coal Measures. It contains several thin seams of coal, which are not of much practical importance, but may prove available at some points for supplying the local demand. Of much greater importance to the county is the question whether the Lower Coal Measures, with their bountiful supply of coal, which is wrought in the adjoining counties, continue underneath the Upper Coal Measures into and through Washington county; and if they do, at what depth, and whether their coal is undiminished in thickness, a question that can only be determined by boring or shafting down to the horizon of these coals in the lower measures.

The highest coal-seam outcropping in this county, is one of its highest strata, and, therefore, found only on the east side of the county; and was found some miles south-east of Ashley, just beyond the county line; but it extends into Washington county, and probably through the hills, near Richview, and is apparently the same which has been discovered by Mr. QUICK, near Irvington. The coal is good, but is no where known to exceed twelve inches in thickness. It can therefore only be worked by stripping along its outcrop, where it can be conveniently exposed in ravines or on hillsides.

The next well-defined seam, and one which extends far beyond the limits of this county, is the one at the base of the slaty division, No. 3, of the county section, No. 11, in the Nashville shaft. It is found from fifteen to fifty feet below the Shoal-creek limestone, and appears to vary in this county between four and fourteen inches in thickness; but, near Highland, in the south-east part of Madison county, the same seam is eighteen inches thick, and has there been worked to a considerable extent. It is exposed at the Stone-coal ford, on the Okaw river, in the south-east quarter of section 1, township 1, range 6; and was found in the trial-shaft four miles west of Nashville, in the south-east quarter of section 17, township 2, range 3; also, in the Nashville shaft, in the south-east quarter of section 13, township 2, range 3; then, on the upper course of a branch, in the south-west corner of section 5, township 3, range 2; on Beaucoup creek, and also on a branch in the south-west quarter of section 35, township 2, range 2; and near Little Muddy creek, in the north part of section 21, township 3, range 1.

The next, and more extensively but very irregularly developed seam of coal, is in the upper part of the lower sandstone formation. As far as known, it no where attains a thickness of more than twelve inches, and is mostly thinner. It crops out at various points on Mud creek; and the coal on the east side of Elk prairie, three miles north-west of Elkton, is perhaps the same.

From the foregoing statement, we see that the supply of coal in the county mainly depends upon the prospects in the Lower Coal Measures. The question whether they extend into the county, must be answered with a decided yes. There can be no doubt about it. The limestones and shales which have been struck at Nashville, beginning at a depth of four hundred feet, must be the Belleville limestones. All the strata which have been observed outcropping between the next exposure of these limestones and Nashville, have also been penetrated successively in this shaft. Another question is, whether the coal which underlies this limestone formation in St. Clair and Perry counties, also extends under Washington county. This question has not yet been decided by experiment, but we have again to answer yes, in all probability. There is no reason for supposing that it was not so, while the great regularity with which this coal is known to extend under an area many miles in length and width, would seem to warrant our expectation to see it continue farther.

The depth to the Belleville coal would probably be at Nashville about four hundred and forty or four hundred and fifty feet; that is, three hundred and sixty or three hundred and seventy* feet below the Shoal-creek limestone, which begins in the Nashville shaft at a depth of eighty feet. As we know the range of this limestone in the county, we can approximately determine the depth to the coal at other points, although the thickness of the strata is subject to great variations. The depth would be least in the north-western and western part of the county, and greatest in the north-eastern part. At Richview, where the Shoal-creek limestone lies one hundred and twenty feet below the surface, it would probably be four hundred and eighty to five hundred feet or more to the Belleville coal. This is only half of the depth at which coal is successfully and profitably mined in England. If the demand for coal is sufficiently large to warrant the investment of a large capital, and the employment of a large number of miners, then the obstacles of mere depth can be readily overcome.

*Minerals.*—No valuable minerals have been discovered in Washington county. The shales of the Coal Measures, at various depths, contain much iron ore, in the shape of concretions of carbonate of iron, the so-called kidney-ore; but I have not seen one point where it would seem to occur concentrated in sufficient quantity to be useful as an iron ore.

*Building Materials.*—The county is amply supplied with building materials of various kinds—sandstones, limestones, sand and lime—while brick can be manufactured any where. Timber is also still to be found in sufficient quantity, as nearly half of the county is timbered land, and much of it is of superior quality.

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*This is considerably more than the average thickness of the strata between the Shoal-creek limestone and the No. 6, or Belleville coal, in Madison and St. Clair counties, and it may more properly be estimated at from two hundred and fifty to three hundred feet.

A. H. W.

*Agriculture.*—In discussing the general character of the county, I have already pointed out the great similarity between it and Perry county. Its prairies, post-oak flats, oak barrens and timbered hills correspond closely to those described in the report of Perry county; and all that has been said in regard to them is also applicable to Washington county. The similarity is far less with St. Clair county, where, in many respects, different conditions prevail; and the counties farther north and north-east, along the Ohio and Misissippi Railroad, have also a somewhat different character of their own.

On the upper courses of the creeks we find, generally, much locust, elm, black-walnut, red-bud, etc., and, in the prairies, willow. Lower down, the bottoms, which are mostly subject to frequent overflows, are mainly timbered with white-oak, swamp white-oak, bur-oak, elm, sugar-maple, sycamore, red-bud, pawpaw, pignut hickory, scaly-bark hickory, some laurel-oak, and at more wet points, with water-oak and honey-locust.

The agricultural value of the lands in this county is shown from the above statements. While they do not rank generally with the richest in the State, they are mostly of very fair quality, many of them far above the average; and, when properly cultivated, lands of this kind are more enduring, and yield better in the end, than the flat, wet prairies which are richer in humus.

# CHAPTER X.

## CLINTON COUNTY.

### BY HENRY ENGELMANN.

Clinton county is bounded on the south by Washington county, on the west by the northern part of St. Clair and the southern part of Madison counties; on the north by Bond county, and parts of Madison and Fayette counties; and on the east by Marion county. It embraces townships 1, 2 and 3 north of the base line, in ranges 1, 2, 3, 4 and 5 west of the third principal meridian, with the exception of township 3, range 5, which forms part of Madison county, and of portions of township 1, ranges 1, 2 and 3, which belong to Washington county; instead of which is added the north-western part of township 1 south, range 5. While the western, northern and eastern boundaries follow the township lines, the line which separates Clinton from Washington county is formed by the Kaskaskia river, from the St. Clair county line to the mouth of crooked creek; then by the latter to near the mouth of Grand-point creek, whence it runs due east to the meridian line, along the section lines, two miles north of the base line. The county thus includes an area of nearly fourteen townships, or about four hundred and eighty-seven square miles, the larger portion of which is prairie.

This county is well watered, first by the Kaskaskia river, which passes from north to south through the whole width of the county, east of the center, and then forms its southern border; then in the western part by tributaries of the Kaskaskia, running parallel to the upper course of the main stream, from north to south; then by Sugar creek, and by Shoal creek and its tributary, Beaver creek. In the eastern part of the county, the branches, on the contrary trend more toward the west or south-west, and are the East Fork in the north and Crooked creek in the south, with its tributary, Lost creek, and some others of minor importance.

Along the principal water-courses we find timbered bottom lands, and more or less wide belts of timbered upland, while the intermediate uplands are prairies. In the western part of the county, long prairies, extending from north to south, alternate with belts of timber. They generally decrease in altitude toward the lower course of the streams. The eastern part of the county is, however, much flatter, and timber is scarce, except along the main streams, the East Fork and Crooked creek, and diminishes rapidly on the smaller branches. Although some of these are many miles in length, and drain large areas, they have the appearance of mere prairie drains. East of the Okaw timber, the county is mainly prairie, and rather uniform and comparatively low and wet.

The prairies are in part similar to those of the adjoining county of Washington, especially in the eastern part of the county; but we find here also a class of prairies which were not observed there—the low bottom prairies, like the Santa Fe prairie, in the principal bend of the Kaskaskia river. There is no definite land-mark between that prairie and the river bottom—no elevated bank whatever; and the bottom timber gradually yields to the grasses, so that there is an intermediate district occupied by oak-openings, where patches of prairie alternate with clumps of trees, mainly consisting of the water-oak. Most of this prairie is so wet that it is covered with the coarsest grasses, and absolutely needs artificial drainage before it can produce the ordinary crops. The uplands proper begin only at the north-west side of this prairie, along which a line of hills extends across the bend of the river, at the foot of which the latter, perhaps, once had its bed.

I have noticed such oak-openings also at various other points, especially along the east side of the Okaw timber, toward Grand prairie. They often form a sort of a second bottom, only a very little elevated above the heavily timbered bottom. Their principal growth appears to be the pin-oak or water-oak, while at other points we observe also much laurel-oak, especially where the ground is somewhat higher, and forms the margin of an upland prairie. These openings are by no means confined to low ground, but occur also on the highest prairies; for example, at the south end of Carlyle prairie, east of Shoal creek.

Grand prairie, east of the Okaw river, differs somewhat from those heretofore described. In other prairies, wherever we found a ravine of any size, we found along it its timber belt, which intersected the prairie. Here, creeks many miles in length, which at certain seasons discharge vast volumes of water, appear only as slightly depressed prairie drains, the course of which is hardly marked by a few bushes. This is due partly to the flatness of the land; but the changed quality of the soil is not without its influence in this respect. The sub-soil in this part of Grand prairie, and at some points farther west in the county, consists of a thick layer of hard-pan, which differs in thickness, and also in quality, from any hard-pan in the sub-soil which I have observed in the counties farther south. It forms a prominent feature in the prairies of this part of the State, and exercises a leading influence upon the agricultural value of the lands.

The timber in Clinton county is still of the same type as that farther south, in Washington and Perry counties; and the only existing differences are produced by the gradual change of the surface configuration. The post-oak is still extensively distributed, and we even find some regular post-oak flats, with white soil and level surface, covered with post-oak and black-jack, and a few black-oak. It is thus on the Ohio and Mississippi Railroad, between Shoal and Beaver creeks, and also north of Santa Fe prairie, near the north-east and south-east corners of the county. The post-oak also prevails in the belts of timbered upland, along the streams, and at some other points, together with black-oak, some white-oak, black-jack, barren-hickory, pignut-hickory, and, in damp places, water-oak, laurel oak and locust, and at the edge of the prairies we find the crab-apple and wild plum.

The bottom timber of course varies with the different characters of the bottoms. It is generally quite heavy. The water-oak is most abundant, together with the swamp white-oak; but then we find also much bur-oak, red-oak, and at dry points even white-oak; also black and white-walnut, silver-maple, locust, sycamore, white and red-elm, pig-nut and shell-bark hickory, box-elder, red-bud, hazel, haw and other trees, and, on the Kaskaskia, also some cotton-wood.

## *Geological Formations.*

The geological formations of Clinton county consist mainly of the Upper Coal Measures. They form the continuation of the strata which we have found in Washington county, especially of their upper portion, and overlie those exposed in St. Clair county, including the Lower Coal Measures and Belleville coal.

In Clinton county, we find some thin strata of coal in these Upper Coal Measures, which might be advantageously worked at some points by stripping along their outcrops, and thus supply a limited local demand. The main reliance for a supply of coal, however, must be placed upon the coal of the Lower Coal Measures, which can only be reached at a considerable depth by extensive mining operations. I have no doubt that the lower coals continue from St. Clair county eastward, and extend at least under a part, if not under the whole of Clinton county, although at an eastwardly increasing depth. If this is the case, it can be made accessible, whenever the demand renders its exploration necessary and warrants the investment of a sufficient amount of capital to prosecute mining operations on an extended scale.

The following is a section of the strata of Clinton county, in descending order:

1. *The Upper Sandstone Formation*, corresponding to the formation of the same name in Washington county. It appears to consist, in Clinton county, mainly of shales, many of which are arenaceous and full of concretions of

carbonate of iron, interstratified with thinly-bedded sandstones. This formation, as developed in this county, presents several calcareous intercalations, especially one near its base and another one in its upper portion. Of these, none contain sufficient lime to form a heavy layer of limestone; but it is combined with the prevailing material of the formation to form calcareous sandstones, calcareous mud-stones and calcareous slates, or it forms only calcareous concretions in the other rocks, which seem to be continuous over extensive areas. In the upper part of the formation, a seam of coal has been observed at different points, from ten to twelve inches in thickness, in close proximity to one of these calcareous layers. The upper sandstone formation occupies mainly the eastern part of Clinton county, beyond the Okaw river, but its lowest strata extend as outliers even west of Shoal creek. Its aggregate thickness has not been definitely determined, the exposures being too far apart and too small to afford a complete section of these strata, which, besides, are probably quite variable.

2. *The Shoal-creek Limestone.*—This rock corresponds very nearly to the description given of it in my report on Washington county. It is a light-colored, mostly light-bluish-gray limestone, with a fracture varying from sub-conchoidal to uneven, and a sub-crystalline and compact texture. Generally, it is hard and more or less silicious, and at some points argillaceous. It sometimes forms layers of eighteen inches or more in thickness, sometimes thinner ledges, and at most points quarries well, and is finely adapted for building purposes. Its thickness varies between six and eleven feet, and is generally about eight feet.

The Shoal-creek limestone contains numerous fossils, which, however, are somewhat difficult to obtain on account of the hardness of the rock. These have been already enumerated in the foregoing chapter, and the list need not be repeated here.

The name, Shoal-creek limestone, has been given to this bed because it is most prominently exposed in numerous outcrops on Shoal creek and in its vicinity, and we find there no other limestone with which it could be confounded. It occupies a large area in Clinton county, beginning in the north-west part of the county, at the St. Clair and Madison county lines, and extending along the north line at least to between Beaver creek and Okaw river, and farther south to the Okaw itself, and then even crosses it to Crooked creek; it does not, however, apparently reach into the extreme south-west part of the county, which is occupied by lower rocks.

3. *The Slaty Division.*—I retain this division as I have distinguished it in my report on Washington county. It embraces the strata between the Shoal-creek limestone and the lower sandstone formation, and consists mainly of slates and shales, and, in places, some sandstone, with a seam of coal of from ten to eighteen inches in thickness. Below the limestone we generally find some black laminated slate, frequently with a couple of feet of gray shales inter-

vening between the two; then black or gray shales, or shaly sandstones; and finally the coal, with or without black slates above it. Of the limestone which I observed in Washington county with these strata, I hardly found a trace in Clinton county. The thickness of this formation also appears to be less, and to vary between twelve and twenty feet. Its whole thickness has, however, been observed only at a few points.

The black slates of this division, at some places, are rich in fossils, beautifully preserved in sulphuret of iron. Among them are, *Bellerophon carbonarius*, *B. percarinata*, and others; several species of *Marocheilus*, *Pleurotomaria grayvillensis*, *P. sphærulata*, *Euomphalus*, *Nucula*, *Orthoceras*, *Corals*, some bivalves and fish-teeth.

4. *The Lower Sandstone Formation.*—This formation is hardly exposed in Clinton county, although it undoubtedly underlies the extreme south-western part of it, immediately below the Quaternary deposits. The sandstones, which at a few points crop out underneath the Shoal-creek limestone, appear to belong to the slaty division. No shaft has been sunk in Clinton county from which a correct section of this formation might be obtained, and I therefore refer to what I have said in relation to it in my report on Washington county. There it is two hundred and seventy feet thick in the shaft at Nashville, but its thickness appears to be variable. At some points it may be greater; at others, less; and I believe it to be less in the north-east part of Clinton county, because, in the coal-shaft at Summerfield, only two and a half miles west of Clinton county, in which by far the largest part of this formation would seem to have been penetrated, it was found not more than one hundred and seventy feet thick.

Below the lower sandstone formation the Belleville limestone would follow, and the lower Coal Measures, with their main coal seams. As these have, however, not thus far been discovered in the county, the probability of their existence below the surface will be considered in what we shall have to say on the Economical Geology of this county.*

On Okaw river, as far as it forms the south line of the county, no outcrop of rocks whatever has been discovered, except at its south side, and therefore in Washington county, at the Stone-coal ford, a little west of the range line between range 3 and 4. There, as has been described in the report of Washington county, we find in the bank of the river a few feet of argillaceous shales, and above them some ten or twelve inches of coal, and some black slates; also, loose pieces of a brown, highly-fossiliferous limestone, and large tumbling masses of the overlying Shoal-creek limestone. The river then appears to run through the slaty strata below the Shoal-creek limestone, which latter may be in place in the hills on the south bank of the river. Farther west, the Okaw river undoubtedly passes through the lower sandstones, but they are nowhere exposed, nor have they been struck in the wells on the low prairies on the north side of the river, which are all in the Quaternary deposits.

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* While these pages are in press, I am informed by Ad. F. Bandelier, Esq., of Highland, that coal, probably the Belleville seam, has been reached at Trenton, on the Ohio and Mississippi Railroad, in this county, at a depth of 810 feet. A. H. W.

On the lower course of Sugar creek, no rocks are exposed; but in a well on the hills in the large bend of the creek, in the north-west quarter of section 3, township 1, range 5, the Shoal-creek limestone has been struck at a depth of hardly thirty feet, and at various points of that bend, in the north part of section 3, and in the south half of the adjoining section 34, township 2, range 5, large masses of this rock are found in the banks of that creek, which partly appear to be in place, while most of them are tumbling, or have at least slipped down several feet from their original position in the higher part of the banks. It is evidently the obstruction presented by this rock which has caused the large bend of Sugar creek at this point. The limestone was also observed, apparently just slipped out of its original position, in the south-west quarter of section 27, township 2, range 5, and, also, in the south-east quarter of section 28. Fragments of black slate and coal were noticed occasionally on this part of the creek, and had evidently come from underneath the limestone, but may have been carried some distance by the water.

Near the middle of the east half of section 28, township 2, range 5, the Shoal-creek limestone forms the bed of Sugar creek, at the Rock ford, and is divided in large rectangular blocks by wide vertical fissures. The trend of the principal fissures is north of east, and that of the subordinate ones east of south. From this point the limestone rises in every direction, especially to the westward. A few rods farther north, the black slates which underlie the limestone, form the bed of Little Sugar creek, dipping several degrees to the eastward; and farther up this creek, through section 21, above and below the railroad, and also in the south-west quarter of section 16, and in the south-east corner of section 17, near Trenton, and on a western branch in the north-west quarter of section 28, shales and shaly sandstones are exposed, which underlie the limestone and belong to the slaty division. The limestone has been quarried at a higher level in the west half of section 21, on the east side of Little Sugar creek, and also in the hills in the east part of section 22, south of the railroad. On the main creek it outcrops in this vicinity, and has been quarried extensively in a high bank south of the railroad bridge, in the south-east quarter of section 22 (?). There I observed, from the bed of the creek upwards: Six feet of black shales, partly gritty, with harder concretions; then, two feet of black laminated slate; two feet of gray shales, and six and a half feet of the limestone—the lower four feet in one heavy bed, and the upper two and a half feet in thinner layers. Higher up Sugar creek no more outcrops of rock occur in this county; but in the south-west part of Madison county, about two miles north of the Clinton line, the Shoal-creek limestone once more forms the bed of the creek, in the south-east quarter of section 21, township 3, range 5, and from this point also rises to the east and west.

West of Sugar creek, the limestone is exposed at a far more elevated point in Madison county, at the coal-diggings north of Highland. At the latter town it has been penetrated in the coal-pit, fifty-three and one-half feet below the surface. Nearly six miles farther south, just east of the point where St. Clair, Madison and Clinton counties corner, it is exposed in the bed of a ravine, near the head of a branch of Sugar creek, on the south-east quarter of section 31, township 3, range 5, and also a mile lower down in that branch, in the north-west quarter of section 5, township 2, range 5. In a well, close to the latter point, the underlying thin coal-seam has been penetrated. Farther down on this branch, we find only some outcrops of the slaty division of sandstone, near the west line of section 4, and of shales, at several points near to the main creek, while large masses of the limestone were noticed tumbling from the higher hills at different places.

At Trenton a coal-pit is being sunk on the railroad, in the south-east quarter of section 19, township 2, range 5. The Shoal-creek limestone does not reach that far west. The strata next the surface are those of the next lower slaty division. The following section was obtained there:

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|---|---|---|
| 1. Soil and yellow clay | 27 | feet. |
| 2. Shales, partly arenaceous | 8 | " |
| 3. Black slate | 2 | " |
| 4. Consisting of 5 inches coal, 7 inches shale, 12 inches coal | 2 | " |
| 5. Shales | 1 | " |
| 6. Solid sandstone | 4 | " |
| 7. Shales and slaty shales | 52 | " |
| 8. Sandstone, alternating with shales | 36 | " |

The shaft had attained a depth of one hundred and thirty-two feet at the time of my visit. The slaty division reaches to No. 5; the following numbers belong to the lower sandstone formation, which undoubtedly continues considerably deeper. The coal of the slaty division is seventeen inches thick in the shaft, in two layers. This coal has also been struck one and a half miles farther north, in a well at Mr. Rutherford's, near the north-east corner of section 18. The coal found in a well two miles farther south-west, half or three-quarters of a mile beyond the St. Clair line (at Mr. Utley's), may be the same, or else a lower seam. In the wells in the prairie south of Trenton, no rocks are struck, and no clue obtained to the geological structure of the country.

East of Sugar creek the Shoal-creek limestone has been struck in wells at the edge of Shoal-creek prairie, near the middle of the north line of section 36, township 2, range 5, at the depth of thirty-two feet, and south-west of the station at Hull, near the middle of the west line of section twenty-four, at the depth of thirty feet; but no rocks have been struck any where else in this vicinity. Some miles farther north, near the south-east corner of Madison county, in the high rolling prairie, the limestone has been found in a well half a mile north of that corner, and again half a mile farther north, near the south-west corner of section 30, township 3, range 4, at Mr. F. BLACET's, where it was eight and a half feet thick and thirty and a half feet below the surface. In a well near Sugar creek, on lower ground, in the north-east quarter of section 2, township 2, range 5, only tumbling limestone and slates were observed, while the rocks in place were lower strata, and mainly arenaceous shales. Close to the point where Madison, Bond and Clinton counties corner, on Mr. JOHN R. BLATTNER's farm, in the high prairie, the limestone is also said to have been struck at a depth of sixty-two feet, and to have been twenty-two feet thick; but this is evidently a mistake.

In the central part of Shoal-creek prairie, throughout its whole length from north to south, no rocks have thus far been discovered in wells; but on the east side of the prairie, and on Shoal creek, we again find the limestone. About three miles east of the last-named point, and half a mile south of the Bond county line, the Shoal-creek limestone crops out in a ravine in the prairie, in the middle of the east half of section 4, township 3, range 4, and has been struck in wells east from there, especially at Jamestown, near the middle of the west half of section 2, at the edge of the prairie, where it is about forty feet below the surface, and underlaid with slate. At the bridge over Shoal creek, still farther east, in the south-east quarter of section 2, the limestone forms the bed of the creek, and is here also divided in large rectangular slabs by vertical fissures, which cross it at right angles.

The coal of the slaty division underneath the limestone is exposed not far from Jamestown, a mile north of the Bond county line, near the north-west corner of section 34, township 4, range 4. It crops out there in the bed of the Locust branch of Shoal creek, and is said to be from fifteen to eighteen inches thick. It has a fine appearance, and is capped by eight feet of gray, slaty shales; then follow eighteen inches of black laminated slate, and two feet more of shaly slate, above which the limestone sets in. The distance from the limestone to the coal is at least eleven and a half feet, and this section closely corresponds to the one on Sugar creek, below the railroad bridge. The limestone is more exposed in the hillsides farther east, but the strata dip in that direction. Near the middle line of the section, the black slates disappear underneath the bed of the creek, and a little farther on, the limestone forms the creek level. The coal could probably be worked profitably by stripping along its western outcrop.

On Shoal creek the limestone disappears underneath the water-level, a little below the bridge, and the rocks which we find in the south-west quarter of section 1, and in sections 11, 12 and 13, overlie it, and belong to the upper sandstone formation. They dip perceptibly to the eastward, and consist of slaty and arenaceous shales and shaly sandstones, with calcareous or ferruginous concretions, and are at least fifteen feet thick, and capped by a calcareous sand-rock, changing into an impure limestone, which varies in thickness from a few inches to two feet. On an eastward bend of the creek, in section 24, we observed the same limestone, with an eastern dip which is so strong that, at one end of the exposure, it is at the water's edge, while at the other end it is eight feet higher, and underlaid, as on Sugar creek, with eighteen inches of gray or blue shale, from eighteen inches to two feet of black slate, and below that by five feet of shaly, arenaceous strata. On the next lower bend to the westward, in the north-east quarter of section 26 (?), at an old mill-seat, the limestone also forms the bank of the creek, from the low-water mark upward. I noticed there also large blocks of a rotten, tumbling, impure limestone, which either immediately overlies the Shoal-creek limestone proper, forming a bed of transition to the upper strata, or else has slipped down a few feet from above. If it does not form the immediate continuation of the above-named impure limestone, or calcareous sandstone, it is at least closely allied to it, and contains numerous fossils, among which are *Productus costatus* (?), *P. longispinus*, *P. Prattenanus*, *P. punctatus* (?), *Spirifer cameratus*, *Athyris subtilita*, and numerous *Bryozoa*, *corals*, etc.

The Shoal-creek limestone rises west from there to the level of the high Shoal-creek prairie, and is exposed in the south-east quarter of section 22, township 3, range 4. It has also been found in the branches a mile farther north-east, in the north part of section 23 (?), where Mr. POTTS dug for coal underneath the limestone, and came to the black slate and shales, and found six inches of coal. Farther south, the limestone also crops out in a ravine at the edge of the prairie, in the north-east quarter of section 34, and south-eastward down along that ravine to Shoal creek, through section 35, and has been quarried extensively. At the highest outcrop in section 34, it is from eight to eight and a half feet thick, divided in thin layers of a few inches each, underlaid with black slates, and capped with about two feet of a firm, somewhat calcareous sandstone, very similar to the one which I had observed a few feet above the limestone on Shoal-creek, below Jamestown, and perhaps an equivalent of the impure limestone described above. Lower down on the branch, I observed, underneath the limestone, several feet of soft, shaly sandstone, perhaps with some slate intervening between the two. A few yards above the mouth of the branch, near the middle of the south line of section 35, township 3, range 5, the limestone is eight and a half feet thick, and from eight to sixteen and a half feet above the bed of the ravine.

At the bridge over Shoal creek, in section 2, township 2, range 4, the Shoal-creek limestone is still in the bank of the creek; but it is better exposed in the same position at the south side of the next lower bend. Above it we find about fifteen feet of slaty shales, arenaceous shales, and shaly sandstone, capped with a layer of calcareous sandstone, which changes to an impure limestone, with numerous fossils. At the Blue Mound, in the north-west quarter of section 3, water is obtained before reaching the limestone, and also in the prairie north of it; but between that point and Breese the shaly strata are struck which overlie the limestone, and sometimes the limestone itself.

At Breese, which is situated in the prairie, in the east half of the north-west quarter of section 22, township 2, range 4, the wells are mostly in the Quaternary deposits, but some have penetrated the lower strata. Thus, Mr. MARKS, at a depth of sixteen feet, came upon shaly, arenaceous strata, and sunk through them to thirty feet below the surface, after which he bored to a depth of fifty-two feet. The boring passed through two very hard strata, at a depth of about forty-five feet, one of which was three or four feet thick, and between them there were several feet of soft clay. These two layers were undoubtedly the Shoal-creek limestone, and the clay filled one of its numerous crevices. West of Breese, no rock is struck in the prairie; but on the Carlyle road, east of Breese, the bank of Shoal creek is formed of limestone, in the north-west quarter of section 24. Below this point, no more outcrops of rock are found on Shoal creek, although the limestone formation extends considerably farther southward. The valley has a wide and rather wet bottom, which is heavily timbered, and much resembles the Okaw bottom. There are a few high escarpments on the creek, especially one south-east of Hanover, in the south-west quarter of section 11, township 1, range 4, below the bridge, on the east side, where the creek washes the foot of the high hills, composed of Quaternary deposits.

Between Breese and Hanover, Shoal-creek limestone has been found in several wells at no great depth, and water has mostly been found on reaching it; thus, in the east part of section 28, and in the east part of section 33, township 2, range 4, also in the north-east quarter of section 4, township 1, range 4. In the north-west quarter of section 3, it was found only eighteen feet below the surface, five feet thick, and underlaid with at least five feet of black slaty rock. These are the most southern points where the limestone or any other rocks have been discovered in this district.

At Hanover, which is located in the south-east quarter of section 4, the water is obtained in quicksand. On a high hill farther north-east, near the center of section 34, township 2, range 4, which overlooks the prairie, and is covered with timber, a well has been dug, mainly through loose sand, to a depth of seventy feet, when shales appear to have been found. The Alluvial deposits seem to be equally heavy in the hills, which extend from Shoal creek to the Okaw, north of Santa Fe prairie, east and south-east of Hanover. In some of these wells pieces of browned wood have been found at considerable depths, but no rocks of older formations.

Between Shoal creek and Beaver creek, in Beaver prairie, water is generally obtained in sand or gravel, at a depth of seldom over twenty five feet; and on the higher hills in the prairie, in the same formation, at forty or fifty feet. Rocks have only been struck in three wells, as far as I could learn. They show, however, that the same formation continues under this prairie. At the western edge of the prairie, not far from an outcrop of the Shoal-creek limestone, on Shoal creek, this rock has been found in digging a well near the north-west corner of section 30 (?), township 3, range 3, while a couple of miles farther east, in the north-west corner of section 28, black slate was found in another, evidently the same which underlies this limestone. Farther north, in the south-west quarter of section 3 (?), township 3, range 3, on the east side of the prairie, limestone is also said to have been found thirty feet below the surface.

On Beaver creek not a single outcrop has been discovered. Pieces of a limestone, apparently of the Shoal-creek bed, were, however, observed at various points at the foot of high alluvial banks, together with drift pebbles, east of the last named point, near the north-west corner of section 11, township 3, range 3, and on the east side of section 15. It would hardly be judicious to conclude that this rock was in place close by, although it is not unlikely, because it has been discovered still farther east. A quite similar bank occurs near the mouth of the creek, in the north part of section 1, township 1, range 4; and I have no doubt that the limestone passes through the hills near that point.

On a hill, near the Flat branch of Beaver creek, in the north-west quarter of section 6, township 3, range 2, limestone was struck in a well thirty-six feet below the surface, which appears to be the Shoal-creek limestone. It did not reach quite across the well, which must have struck a wide crevice in the rock. The latter was about four feet thick, and underneath it black slate was found by boring. On much lower ground, near the center of the section, the black slate was also found at a depth of twelve feet. A mile and a half farther east, near the south-east corner of section 5, on a hill, a well penetrated through forty feet of Quaternary deposits, and then fifteen feet in shales and slates. These may perhaps be higher than the limestone. Farther south-west, in the north part of section 18, over a prairie ridge, shaly arenaceous strata are said to be found, only a few feet underground, which probably overlie the Shoal-creek limestone. At other points the alluvial deposits are very heavy, and in Carlyle prairie, between Beaver creek and the Okaw river, rocks are of very rare occurrence.

At Carlyle, the Shoal-creek limestone crops out again, near the north line of section 19, township 2, range 2, at the chain-bridge, in the banks and bed of Okaw river. In the town, in the south-west quarter of section 18, a thin, hard areno-calcareous stratum, a highly calcareous sandstone, crops out in a ravine; at other points, a highly arenaceous limestone; and the same has been struck in various wells in the town. Between it and the Shoal-creek limestone, which is about seventeen feet lower down, slaty and arenaceous shales intervene. The Shoal-creek limestone is here reported to be eleven feet thick. The areno-calcareous stratum evidently corresponds to a similar one, which I have observed at several points near Shoal creek, as I have stated above. It is exceedingly full of fossils, especially *Bryozoa*, and also *Productus*, *Spirifer*, and many others. Underneath the Shoal-creek limestone black slate has been found here, and below that, arenaceous shales and sandstone, apparently of the slaty division, which appears to be thicker here than farther north-west, or at Nashville, in Washington county.

The Ohio and Mississippi Railroad Company bored, west of Carlyle, one hundred and eighty feet deep, but no trustworthy report could be obtained in relation to this undertaking. The great thickness of coal which was expected at a small depth, was of course not found; but it seems that the thin stratum of the slaty division was passed through.

The next outcrop south of Carlyle, is at Clabough's quarry, on the Okaw, two and a half miles from the last one, on the east side of section 36, township 2, range 3. In the west bank of the river we find ten feet of irregularly stratified sandstone and arenaceous shales, capped by some black slates; then, eighteen inches of gray shale, and above that, eight feet of Shoal-creek limestone. The latter is here mostly very hard, and is not as fine a building material as at most other points. No other rock is exposed above it. It rises considerably to the north-west, and is therefore exposed far up, along a ravine which comes from the hills at the quarry. A mile farther south-west, this limestone once more crops out in the bank of the Okaw river, and on the lower end of a branch in the south-west quarter of section 36, township 2, range 3. It is over eight feet thick, and here also rises to the westward, so that the underlying slates form the bed of the branch in the east part of section 35, above the quarry; and still higher up, in section 35 and on the east side of section 34, the underlying sandstones are exposed in its bed.

The river once more impinges against the hills on the west side, a short distance above the upper end of Santa Fe prairie, at the fish-trap, in the south-west quarter of section 1, township 1, range 3. The exposure is quite imperfect. We find on the bank and in the river, numerous large blocks of a limestone, which is apparently the Shoal-creek stratum; also, calcareous sandstones, somewhat resembling the above described areno-calcareous stratum overlying the limestone; and blue slates, partly in place in a ravine. It seems to me as if the bed of the river was formed by the sandstone of the slaty division, which formed the bank at Claybough's quarry; that, higher, follow the slates; and still higher, the Shoal-creek limestone; and that these strata dip strongly to the eastward. The higher strata, above the limestone, are perhaps not in place in this hill. The summit of the hill has a heavy covering of alluvial deposits. Between this point and the Stone-coal ford, there are no more outcrops of rocks on the river.

North of Carlyle about two miles, the bed of Okaw river is said to consist of rocks, but I could not see them; and the banks were composed of alluvial deposits. A quarter of a mile farther east, near the north-west corner of section 8(?), township 2, range 2, a well struck on solid rock, and water was obtained by boring through it. On a branch which empties near by, and at several points in section 5, large slabs of the areno-calcareous rock are reported to have been found, which appear to correspond to the stratum which is at Carlyle seventeen feet above the Shoal-creek limestone. I noticed the same rock in the bed of the branch in the middle of the north half of section 5, where it has been quarried to some extent, and is overlaid with shaly sandstones. The latter crop out also higher up on this branch, in the south part of section 32, township 3, range 2, and extend through the east part of section 31, where they have also been quarried in a shallow prairie ravine. They contain some firm layers, but are mostly irregularly stratified and shaly. They have also been struck in a well near the center of section 36, township 3, range 3, on the high prairie.

There is only one more outcrop of rocks on the Okaw river, in this county, which is at McClellan's ford, in section 33, township 3, range 2. There the bed of the river is formed of sandstones, which probably form the continuation of the last-named rocks, and belong to the upper sandstone formation. A short distance west of the ford, at the foot of the hill, a thin seam of coal is said to have been exposed, but no trace of it is to be seen at present.

Keysport is situated on a very high bank of the river, not far from the north line of the county, in the north-east quarter of section 2, township 3, range 2; but no traces of any rocks are found in this vicinity, nor for several miles up and down the Okaw, or on the East fork in the north-eastern part of the county, except at Casey's mill, in the north-west quarter of the north-east quarter of section 13, township 3, range 1. In the bank of the creek I here observed argillaceous and arenaceous shales, with intercalations of sandstone; and in the bed of the creek below them, black, highly calcareous and fossiliferous slates, at least a foot thick. Besides, I noticed pieces of ordinary black laminated slates, and a more purely calcareous rock, which probably come from another point of the same stratum. Underneath the calcareous slate, in the bed of the rock, twelve inches of coal are said to have been found in digging. These strata evidently belong to the upper sandstone formation, which is more extensively exposed a little farther up the creek, in Marion county.

No rocks have been discovered in Clinton county, east of the Okaw, from the East fork to Crooked creek; but on the latter we find outcrops of the upper sandstones. On the low hills on the south side of Crooked creek, in Washington county, these sandstones were found on the west side of section 26, township 1, range 2, and at various points thence eastward. In the report of Washington county, I have also referred to a reported outcrop of rocks, perhaps of the Shoal-creek limestone, farther west in the bed of Crooked creek, in the south-east quarter of section 21, and to the tumbling limestones below this point; also, to the outcrop of areno-calcareous rocks at Joliff's mill, on Crooked creek, in the north-east quarter of section 25, or the south-east quarter of section 24, township 1, range 2. There, I found in the bank of Crooked creek, from two to two and a half feet of a finely-grained, grayish-blue calcareous sandstone, or mudstone, of not quite uniform composition, and with a brown surface. It contains numerous fossils, especially *Productus*, *Spirifer*, *Myalina*, etc., and is underlaid with a few feet of arenaceous shales. I expressed the opinion that it probably corresponded to a similar stratum which had been found in the pit at Nashville, sixty-two feet above the Shoal-creek limestone. It resembles, also, in many respects, the areno-calcareous stratum observed at Carlyle, and on Shoal creek, seventeen feet above the Shoal-creek limestone; and all of them may perhaps be one and the same, although I am by no means positive in regard to this point. Farther east, apparently higher sandstones and shales had been observed on Grand-point creek, a mile above its mouth, in section 29, township 1, range 1, and on Crooked creek, in Clinton county, a little above the mouth of Grand-point creek, in the south-west quarter of section 19, township 1, range 1, similar strata crop out. Thence, up crooked creek, we find no more rocks exposed until we approach the Marion county line, near Central City.

At Joliff's mill, at the bridge over Crooked creek, on the road from Central City to Carlyle, (which should not be confounded with another old mill of the same name, six miles lower down Crooked creek, in Washington county, which I have mentioned above), in the north-west quarter of section 1, township 1, range 1, I observed another stratum of calcareous sandstone, very similar to that already described. It is thirty inches thick where it is best developed, and here dips beneath the water level to the westward, but is seen again in the bank a little farther west. It contains the same fossils as at the other localities.

In digging at the bridge, a thin seam of coal, about a foot in thickness, was found about twelve feet below this calcareous sandstone. It is the same which is exposed at the ford of the creek, north of Central City. Above the sandstone, at the mill, we noticed a considerable thickness of shales, which are partly arenaceous and contain concretions of carbonate of iron. Such shales are also exposed in the bank of the creek, near the west line of this section 1, township 1, range 1, which is the last outcrop to the westward for a considerable distance; but I rather think that they underlie the calcareous sandstone, and are not the same as at the bridge. Up the creek, toward the Marion county line, the same strata continue. The calcareous sandstone is frequently found, either in place or tumbling, in the upper part of the bank; in the lower part the underlying shales crop out, which, at some points, also contain calcareous portions, full of fossils. Near Central City, beyond the county line, we find some ledges of sandstone interstratified with the higher shales, and at the ford above the railroad bridge north of Central City, the coal is ten or twelve inches thick, and the next lower strata consist of three or four feet of shales, with some concretions of iron ore, and then three feet of slates, the lower part of which are shaly and somewhat arenaceous, and the upper, dark-colored, bituminous, calcareous, and full of fossils similar to those in the higher arenaceous stratum. A complete section of the strata on Crooked creek, near the Marion county line, would therefore be about the following, in descending order:

1. Shales, partly arenaceous, with, in places, some layers of sandstone, and much kidney ore, at least 35 feet thick.
2. An areno-calcareous layer, with numerous fossils, generally a hard calcareous sandstone, which varies between 1½ and 2½ feet in thickness.
3. A seam of coal, 10 or 12 inches thick.
4. Shales, partly arenaceous, with kidney ore. At some points these change not far below the coal into dark-colored calcareous slates, with fossils.

At first it would seem as if the areno-calcareous stratum at the Joliff's mill, near Central City, was the same as the one at the other Joliff's mill, six miles farther south-west; but, upon mature deliberation, I came to the conclusion that they are probably different; that the latter is much lower in the upper sandstone series, to which they both belong, and that the coal-seam underneath the upper one, corresponds perhaps to the one on the east side of Washington county, high up in the upper sandstone formation; and also to the one on the east fork of Okaw river, at Casey's mill. The calcareous rocks which are connected with these coal-seams, vary considerably in appearance, but they may nevertheless be of common origin and contemporaneously formed. The difference between them is not greater than between different outcrops of evidently the same formation, higher up on the east fork, and at other points in Marion county, which will be described in the report of that county; and is due to the different form in which a small amount of lime has been deposited while an arenaceous and shaly formation was being formed; so that we find it now either as a thin ledge of limestone between shales and sandstones, or as a calcareous sandstone, or as a calcareous mudstone, passing into a calcareous slate or slaty limestone, or as a sort of pudding-stone or concretionary limestone.

## *Economical Geology.*

*Coal.*—From the foregoing remarks, it appears that the upper part of the Coal Measures occupy the whole of Clinton county, and that the higher strata of this formation gradually succeed above the lower ones to the eastward. In these upper Coal Measures we find principally two coal-seams, which are of some importance, although they are thin. One is in the highest part of the formation, in the upper sandstones; the other one at the base of the slaty division, below the Shoal-creek limestone. The first one of these has, up to this time, only been exposed at two points in this county—at Joliff's mill, on Crooked creek, near Central City, and at Casey's mill, on the east fork of Okaw river—both points being situated close to the east line of the county. Being hardly more than ten or twelve inches thick, it can be worked only by stripping along its outcropping edges, and the slightly broken configuration of the surface is not favorable to this kind of exploration. Still it might be of some local importance at a few points, if it was followed up. The other seam has been found from ten to twenty (and in Washington county at least more—at some points as much as fifty) feet below the Shoal-creek limestone, and appears to vary between ten and eighteen inches in thickness. As far as I have been able to ascertain, it has been discovered wherever the strata have been exposed or penetrated at the proper level in this county. It has been found in a shaft at Trenton, at a depth of thirty-two feet below the level of the prairie, and consisted there of two seams of five and twelve inches of coal, with seven inches of shales between them. It has also been observed at several other points in that vicinity. Then it was noticed a short distance north of the county line, on Locust branch of Shoal creek, not far from Jamestown, from fifteen to eighteen inches thick, and at the Stone-coal ford of Okaw river, on the Washington county line, ten or twelve inches thick. Beyond the county line it can be traced south-eastward through Washington county, and probably farther. In Madison county I observed the same coal-seam in the coal-pit at Highland, where it is eighteen inches thick, seventeen feet below the Shoal-creek limestone, and seventy-five feet below the surface; and it is the same seam which has been worked to a considerable extent, one and a half miles north-east of Highland, where it is also eighteen inches thick, and crops out on a branch.

It seems also more than probable that this is the coal-seam which has been found at Central City, just east of the east line of Clinton county, at a depth of one hundred and eighty feet. This seam, therefore, appears to extend nearly all over the county, and undoubtedly might easily be denuded on many a hill-side in the eastern half of the county. At Highland it has been profitably worked to a considerable extent, by drifting, and there is no good reason why it might not be worked in the same manner, or by stripping its outcrops, at many points in this county. It may yet prove of considerable local importance. Wherever the Shoal-creek limestone ranges, its position might easily be ascertained by boring underneath that rock.

The thin seams of coal in the lower sandstone formation do not crop out in this county, and are most probably, too thin to be of any advantage at the depth at which they occur.

The most important geological question for Clinton county, and one which is decisive in relation to her prospects of future development as a manufacturing region, is, whether the stone-coal of the lower Coal Measures extends under her surface—the coal to which the adjoining county of St Clair owes a large share of its vast wealth, which, great as it is, has hardly begun to be developed, and is capable of any conceivable expansion. This is the problem upon the solution of which turns, in a great measure, not only the prospective richness of this county, but also of some of the adjoining counties to the south, north and east.

We know that the Belleville coal of the lower Coal Measures is nowhere near the surface; but it undoubtedly extends at least under the western part of the county, and I can see no good reason to suppose that it does not extend under the whole. Still, we have no positive proof which would substantiate this assertion. At Mascoutah, in St. Clair county, not quite six miles west of the Clinton line, and near its south end, a mine is worked on this coal-bed, at a depth of only one hundred and thirty-two feet. The coal would undoubtedly lie considerably deeper in Clinton county, east of Mascoutah; but I see no reason why it should thin out in that small distance, after having found it extending many miles with remarkable uniformity At Summerfield, on the Ohio and Mississippi Railroad, in St. Clair county, only two and a half miles west of the Clinton line, the coal is also worked in a mine at a depth of two hundred and seventy feet. It is there only from four to four and a half feet thick, and the top coal of the bed is not as much developed as at other points; but this may be due to local causes, and we must not necessarily conclude that the coal was generally thinning out in this section, although it may be so. We can hardly doubt that the coal extends beyond Summerfield into Clinton county; but whether it extends all through the county, and with undiminished thickness, or whether it thins out, can not be ascertained, except by digging or boring. The development of the main coal in the lower Coal Measures is so very uniform over the extensive district of many miles in length, and embracing several counties over which I have thus far been able to follow it up, that I can not believe that it should not also be extensively developed in breadth, and continue far into districts where it is now hidden by overlying strata, as it would be in this county.

Taking, then, for granted that the Belleville coal extends through Clinton county, the question arises as to its depth. It undoubtedly increases to the eastward, where the higher divisions of the Coal Measures prevail; but it is impossible to tell whether it probably follows the same undulations as the Shoal-creek limestone, or not, and whether it has not undulations of its own, which do not extend into the higher strata.

The coal-seams have been formed in marshes, or quite shallow water, while the strata above and below them, of the same formation, have been deposited in a more or less deep sea. The consequent frequent changes of the water-level, during the Coal-Measure period, have caused a greater irregularity in the thickness of the deposits in contemporaneous and adjoining portions of the same measures than in other formations; and we perceive their regularity only by considering them collectively and as a whole, while from a less comprehensive point of view we might fail to recognize it.

We are in possession of a few data from which we may judge of the depth at which the coal may probably be found in this county. At Nashville, in Washington county, the depth of the coal under the Shoal-creek limestone is probably about three hundred and sixty feet. The strata in the pit at Summerfield, in St. Clair county, are lower than this limestone; but I think that if it reached thus far west, it would be hardly more than three hundred feet above the coal. At Centralia, in Marion county, if we may assume the foregoing statement as a fair basis, I placed the depth of the Shoal-creek limestone at two hundred and twelve feet, and that of the coal at six hundred and forty feet, which would give their distance four hundred and twenty-eight feet, which is rather more than I am willing to accept without expressing a doubt as to its correctness. Taking these data as a basis for further calculations, I would give the following numbers as the probable depth of the coal at different points, allowing a large margin for irregularities of the formation, and for other uncertainties connected with the fundamental data of the calculation: In the extreme south-west of the county, near and south of Baden, two hundred to three hundred feet; at Trenton and vicinity, and farther east, about three hundred feet; near Hanover and in Santa Fe prairie, from three hundred to four hundred feet; on the Okaw, near Ogle, near four hundred feet; about the same or a little more toward Keysport, and still more east from there; finally, toward Centralia, six hundred and forty feet, which should, however, be accepted with caution.*

*Minerals.*—Of minerals we only find concretions of impure carbonate of iron, kidney ore, in the shales of the Coal Measures. These, although very extensively distributed, are found no where accumulated in sufficient quantity to be valuable as an iron ore.

*Building Materials.*—As far as the Shoal-creek limestone extends, in the north-west and central parts of the county, it furnishes a superior building stone, and, when burnt, a good, but not very white lime. At a few other points some sandstone is quarried, and on Crooked creek, the areno-calcareous layers. In the south-western and north-eastern parts of the county, rock are not easily accessible, but good brick can be manufactured any where. Timber is also plenty for building and other purposes.

*Agriculture.*—In the chapter on the surfare configuration of the county, I have already described the principal features of the county which combine to determine its agricultural value, and I need not repeat these remarks. The general character of the soil is still the same farther south, over the Upper Coal Measures, which have been described in the report on Perry county. The prairies have, however, gradually assumed a character somewhat different from what it was farther south. This is due partly to their greater extent, and the greater flatness of the country, and, consequently, less complete drainage, and partly to a difference in the sub-soil. The soil is still similar to that of the prairies farther south, consisting mainly of the same impalpable, fine, arenaceous material; and often it is even richer in vegetable mould, and is therefore of a darker color. Its thickness is quite variable—from a few inches to two and a half feet. The sub-soil differs considerably at different points; frequently, however, it consists of a heavy deposit of a hard-pan, several feet in thickness. This hard-pan is a leading feature over a large area in and beyond Clinton county, and is similar to the sub-soil of the post-oak flats, inasmuch as it is also an exceedingly finely-comminuted arenaceous material, a whitish silicious loam, which, when it is dry, is firmly and densely packed, and when it is wet shows little cohesion. In this sub-soil we find a large amount of ferruginous nodules and small lumps of hydrous oxyd of iron. While the sub-soil is full of these dark-brown nodules, it is still whitish, and entirely free from the color produced by oxydized iron. This circumstance indicates the cause of its defective condition, in relation to which I can only repeat what has been said of the white soil of the post-oak flats. In the wet season this sub-soil is saturated with water, and then has little cohesion, and is extremely soft, so that wheels will sink in it as in quick-sand. Then, vegetable substances which it contains ferment, because the air is excluded, and thus act as a deoxydizing agent upon the peroxyd of iron of the nodules and the soil, and form vegetable acids which combine with the protoxyd of iron thus created, instead of decaying and thus forming fertilizing compounds, as they would if the air could gain proper access. The dryness of the summer remedies these defects, but the sub-soil remains closely packed and very imperfectly accessible to the air. The iron has again been precipitated and aggregated to the nodules, and contributes to render the sub-soil so hard and intractable as to make a hard-pan of it. The influence of this sub-soil is little felt where the upper soil is deep and rich; but where it lies shallow, some crops suffer severely, and it requires much labor and good tillage to counteract its influences to a certain degree. How hard it gets may be judged from the fact that, where this hard-pan prevails, the use of chisel-shaped augurs is found most profitable for drilling holes in which to set fence-posts, while the spade and pick are found to work very slowly. Where the soil becomes shallow, and the hard-pan reaches the surface, there we find the so-called "scalds," or barren spots, in the fields. Everything which tends to loosen the sub-soil, will improve it and make it fertile, because it is not necessarily a poor soil and defective in the ingredients which are essential to the healthful development of plants. Sub-soiling alone will not help much, unless deep stirring is continually repeated, because the soil would be packed close by every heavy shower. The most effectual remedy would probably consist in underdraining, whereby the air would gain continual access to the soil. Whether the application of lime would prove beneficial, I cannot tell beforehand; it ought, however, to be tested. Generally, lime renders a soil more mellow; but it also accelerates the decomposition of all organic substances contained in it; and whether this would not outweigh the advantages to this soil, naturally not rich in humus, can be determined by experiment only.

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* These last estimates are probably altogether exaggerated, and the limestone reported in the boring at Centralia, at a depth of two hundred and twelve feet, instead of being the Shoal-creek rock, is most likely a much lower bed, several of which are found between that rock and the Belleville coal, in the shafts in St. Clair county. A. H. W.

At other points, we find in the sub-soil, instead of the ferruginous nodules, calcareous concretions of whitish color. The color of this sub-soil is still white, but I think it is preferable to the other, and can not be without improving influences upon the soil. It would at least neutralize any acid tendency in it, and make it mellower.

Clinton county is fast settling up, and the facility for marketing its produce, by the Ohio and Mississippi railroad, which runs from east to west thirty miles through the county, dividing it into two nearly equal parts, or by the Illinois Central railroad, which runs near its east side, beyond the county line, increase the value of its lands beyond that of many other equally productive districts.

# CHAPTER XI.

## MARION COUNTY.

BY HENRY ENGELMANN.

Marion county is bounded on the north by Fayette county, on the east by Clay and Wayne counties, on the south by Jefferson county, and on the west by Clinton and Fayette. It embraces townships 1, 2, 3 and 4 north of the base line, in ranges 1, 2, 3 and 4 east of the third principal meridian—sixteen full townships, or five hundred and seventy-six square miles, about equally divided into prairie and timber land.

Geographically the county is equidistant from the Mississippi and Wabash rivers, and the water-shed between these, and between the Kaskaskia and Little Wabash rivers, passes through it.

*Surface-configuration*, *Streams*, *etc.*—The north-western part of the county is watered by the upper course of the east fork of the Kaskaskia river, and by its tributary, the north fork, and their branches. In the south-western part of the county we have the upper course of Crooked creek, another tributary of the Kaskaskia river, and its principal branch, Raccoon creek. The eastern part of the county is drained by the upper course of the Skillet Fork of Little Wabash and its branches; while in the extreme north-eastern corner head some branches of the Little Wabash itself. There is no lack of water in the county for all ordinary purposes. Away from the creeks and their branches, water can every where be obtained in wells at a moderate depth.

The principal creeks, especially the Skillet Fork, have along a portion of their course a considerable breadth of heavily-timbered bottom lands, and all the water-courses, except at their very heads, are fringed with timbered uplands. Where the channel of the creek lies deep below the level of the surrounding country, these timbered lands are somewhat broken, passing into rolling barrens and post-oak flats, and where the creeks have shallow valleys, they are rolling or flat.

The central portion of the ridges, and the flat and gently undulating stretches of upland, at some distance from the principal water-courses, are occupied by prairies, which ramify between all the creeks, and comprise about one-half of the whole area of the county. The prairies in Marion county are all either on the same level, or higher than the surrounding timbered lands; while some of them, especially on the main water-shed west of the tributaries of Skillet Fork, present a considerably elevated surface of hills and prairie ridges.

The sub-soil, in part at least, of the prairies of Marion county, is the same white, finely-comminuted, arenaceous loam, with ferruginous nodules or concretions, which, as a hard-pan of considerable thickness, has been observed at many points in Clinton county, and has been described in the report on that county. It forms a prominent feature in the prairies of this and the adjoining counties, and exercises a dominant influence upon the agricultural value of the lands, according to the greater or less depth at which it is found. Where it lies shallow, and comes close to the surface, it produces the so-called "scalds;" where it lies deep beyond the reach of the roots, it exercises no direct influence, except, perhaps, in rendering the land more subject to severe drought than where the sub-strata are more open and permeable to moisture.

The timber in Marion county is the same as in the adjoining counties—such as has been described in the report of Clinton and Perry counties. The post-oak flats and barrens are still developed to a considerable extent, and with their characteristic growth. The barrens are most perfectly developed in the vicinity of the Skillet Fork, where the grasses are being gradually superceded by a growth of timber; and we find on them principally post-oak, and small black and white-oak, together with hazel and sumach. The more broken hills are covered with similar but heavier timber; while the bottom timber is also the same as in Clinton county.

## *Geological Formations.*

The rocks which crop out in Marion county all belong to the Upper Coal Measures—to the division which has been designated in the preceding chapters as the upper sandstone formation, and overlies the Shoal-creek limestone. It has been observed in the eastern part of Clinton county, and in the north-eastern part of Washington county, and described in the report on these counties, with the associated strata; but in Marion county we seem to have only this one sub-division, and the geology of the county therefore presents a great degree of sameness. This formation corresponds, in this county, to the description of it given in Washington county, only we find still higher strata of it, so that it is somewhat thicker. The calcareous matter appears at some points in the shape of strongly cemented, very compact, calcareous sandstones; at others, as a calcareous mudstone or calcareous slate, which is generally full of fossils; and at others still, as an areno-calcareous pudding-stone, or as purer layers of limestone. At a few points this limestone attains so considerable a thickness that one is tempted to consider it as a distinct sub-division of the Coal Measures; but it appears to vary within short distances, and to be merely a local accumulation of calcareous matter. I have at several points seen this limestone thin out within a distance of a few feet. At one point it formed a solid layer; at the next, only single blocks, like concretions or thin slabs; or it changed into a calcareous slate, and close by was lost entirely.

This formation contains at least one coal-seam in this county, which has been discovered at many points in various and distinct localities, and appears to be developed rather uniformly and continuously. At some points it attains a sufficient thickness to be profitably worked for supplying at least the local demand for coal. Other outcrops of coal in the county may represent only local deposits, and appear to be of little importance.

The strata in Marion county do not conform to the general eastern and north-eastern dip, which was observed in Clinton and Washington and the adjoining counties; but they exhibit local undulations, such as we have already observed in Clinton county, with the Shoal-creek limestone. They appear to rise gently eastward toward the main dividing ridge, east of the center of the county, following the general direction of the undulation of the surface; and then they continue horizontal, or dip again slightly to the eastward.

I will now describe the outcrops as they appear in the different parts of the county:

Beginning in the north-west corner of Marion county, we find no rocks exposed on Flat creek, which runs close along the Fayette county line, nor at any point along the North Fork, along its whole course in this county, in township 4, range 1 and 2, nor on the smaller branches. In the shallow wells in the prairies, on both sides of the North Fork, no rocks have been struck; but there can be no doubt that the sandstone formation underlies this whole district.

At Patoka, near the center of the south line of section 28, a well was sunk at the railroad station, deeper than the wells ordinarily are, in order to obtain a large amount of water for a tank. I am informed that it passed through:

| | | |
|---|---|---|
| 1. Soil, clay, etc. | 15 | feet. |
| 2. A kind of hard-pan | 15 | " |
| 3. Blue clay, with sand and pebbles, and with pieces of coal, brown wood, etc. | 30 | " |
| 4. Blocks of limestone, containing some fossils | 2 | " |

By the description which I received of this layer, I was not satisfied whether it was a concretionary limestone and formed a stratum with open joints, and corresponds to a stratum of limestone which I observed farther south-east and east, on the East Fork, below the coal-seam, or whether it consisted merely of tumbling masses of this limestone. Below it they bored thirty feet, through a soft material, apparently shales.

On the east fork of the Okaw, however, rocky outcrops are numerous. In the report on Clinton county, I have mentioned the exposure at Casey's mill, not quite half a mile west of the county line—the first one on the creek from its mouth. It consisted of argillaceous and arenaceous shales, with intercalations of sandstones, and below them of black, highly calcareous and fossiliferous slates, at least one foot in thickness, below which, underneath the water-level, twelve inches of coal have been discovered. These strata form part of the upper sandstone formation of the Clinton county section. I suggested then that this coal and calcareous slaty rock probably corresponded to a similar formation in the western part of Marion county, on the East Fork and Crooked creek.

Turning east up the creek, we find small outcrops of the shales and some sandstone, which is mostly hard and calcareous, near the line of section 17, and again a quarter of a mile below the railroad bridge, in the south part of section 17, township 3, range 1. Arenaceous, shaly strata are also exposed at a higher level on a ravine in the east part of section 19, and have been struck in wells in the timbered hills near the edge of the prairie about there; and sandstones have been quarried occasionally three-quarters of a mile south of the creek, on the west side of the railroad, in section 20, where they are partly soft and yellowish, partly hard, bluish and calcareous.

Shales were observed in the bed of the East Fork, east of the railroad, near the mouth of Davison's creek, which is in the south-west quarter of section 16; and they are also exposed in the banks of the latter, at various points, in the north part of section 21, in section 22, and apparently farther up, while both kinds of sandstone overlie the shales, and were noticed tumbling in large masses in the branch at points where the hills rise steep in the sections just named. Not a trace of the coal has been observed on this creek.

In the north-west quarter of section 15, in the south part of section 10, and in the west part of section 11, sandstones and shales are variously exposed in the banks of the East Fork, and at some points higher up in the hills. In the south-west quarter of section 11, I found heavy slabs of a highly fossiliferous, blackish, slaty, calcareous rock, similar to that of Casey's mill, which must have tumbled down from the higher part of the slopes; and in the center of section 10, near the edge of the prairie, Mr. HAWKINS is reported to have struck a seam of coal in his well, probably the same as at Casey's mill. The sandstones have also been struck in various wells at the edge of the prairie north of the East Fork, in sections 10, 11 and 1, township 3, range 1, but not farther east or west.

On Jim creek, close to its junction with the East Fork, not far from the center of section 12, township 3, range 1, the bank consists, to a hight of about three feet, of argillaceous, slaty shales, with concretions of kidney-ore; then eighteen inches of coal, capped with argillaceous and slightly arenaceous shales. Next underneath the coal, I observed some calcareous rock, which is here quite subordinate and only concretionary, so that it can hardly be said to form a layer; but it resembles and takes the place of the heavy stratum of concretionary limestone which is found some miles farther up the East Fork. I also noticed small slabs of the highly fossiliferous, calcareous, slaty rock mentioned above, which is here again above the coal, but little developed; while a few rods from here, on the East Fork, just below the mouth of Jim creek, it protrudes and has tumbled out of the bank in heavy masses. By digging in the bank there the coal has also been discovered eighteen inches thick. On the East Fork, a short distance above the mouth of Jim creek, the shales, with the kidney-ore and calcareous concretions, reach to a hight of ten feet. Farther up the creek, we find, at several points, alternations of shales and sandstones, as in the north part of section 12, in the south-east quarter of section 1, township 3, range 1, and in the south part of section 6, township 3, range 2. The sandstones are of variable quality, partly purely arenaceous, partly of the calcareous, hard, bluish and splintery variety, partly smooth and easily dressed, and partly hard and ripple-marked. The same strata crop out also farther south on Jim creek, in section 7.

For some distance, then, we find no exposures on the East Fork; but on a branch south of it, not far from the middle of the south line of section 32, township 4, range 2, the coal is said to have been exposed a number of years ago. Then shales, apparently the lower ones, crop out on the main creek, near the middle of the north line of section 33. In the north-east corner of section 33, at the foot of the hills, the coal has also been found in place, capped by nine inches of the black, highly fossiliferous, slaty, calcareous rock, which we have before found at various points. Mr. SMITH, in digging a well at a higher level on the slope close by, in the south-east corner of section 28, struck the overlying sandstone; while at his house on the brow of the hill, not far off, he passed through fifty-two feet of Quaternary deposits. A short distance farther south-east, just across the section line, in section 34, on the south bank of the creek, a more complete exposure was noticed. It consists, underneath the soil, of—

| | | |
|---|---|---|
| 1. Gray slaty shales | 2 feet. | |
| 2. Bluish slate | 1 " | 6 inches. |
| 3. Coal | 1 " | 6 " |
| 4. Gray argillaceous shales | 4 " | |
| 5. Silicious or sandy limestone, 6 inches to | 2 " | |
| 6. Gray argillaceous shales | 6 " | |

The sandy limestone (No. 5) has a concretionary appearance, and is, notwithstanding its great hardness, much cracked and decomposed by atmospheric influences. I had seen a similar rock, less prominently developed, near the mouth af Jim creek. It contains fossils, some of which were also observed in the areno-calcareous strata of Crooked creek, which it resembles in some respects, and of which it seems to form the continuation.

The sandstone struck in the well is evidently higher than No. 1, or rather forms an intercalation in the shales which form the continuation of No. 1. The coal has also been struck in digging a well a short distance east of the last outcrop on the upland, in the north-west quarter of section 34, at a depth of thirty-two feet.

Continuing up East Fork, we find more of the shales and of the calcareous rock from underneath the coal, in the north-west quarter of section 34, and in the south-west quarter of section 27, township 4, range 2. In the latter quarter-section the coal has been dug up near the creek. On Mr. WILDEN's land, close to the center of section 27, it has also been wrought in the lower part of the bank, and is said to have been eighteen inches thick; and it has again been discovered on a small branch south of the East Fork, near the middle of the south line of section 26, capped by the calcareous, slaty rock.

Then the coal has been found on the East Fork, in the north-west quarter of section 25, township 4, range 2, at a former mill-seat, known as Strickler's old mill. It has been dug there out of the bed of the creek, and is said to have been sixteen inches thick; but the only traces of the old digging, which were to be seen at the time of my visit, were fragments of coal and slate, and the fossiliferous and calcareous slate. From this point the strata appear to rise still more toward the dividing ridge, because, south and south-east from here, the coal has been discovered near the edge of the high prairie, not far from the head branches of the East Fork, while on the main creek no more traces of it have been observed. The hills along it are rather high and broken, and evidently contain sandstones; but exposures are quite rare, and consist principally of shaly sandstones and shales, especially in section 19, township 4, range 3; while farther up, in the north part of township 4, range 3, the banks of the creek consist of clay and sand, and the slopes present hardly any exposures.

On ravines running into the East Fork, north-west of Alma, near the edge of the prairie, I noticed numerous small outcrops of shaly and thinly-stratified sandstones; below them, gray shaly strata, with concretions of carbonate of iron; and finally again, the coal, some distance down the branch, in the south-east quarter of section 1, township 3, range 2, at Martin's old diggings. It forms the bed of the creek, and was not exposd, but is said to be at least fifteen inches thick. I found the fragments of black laminated slate, and of the fossiliferous, calcareous slate, but the limestone seems not to have been prominently developed at this point.

Alma is situated on the high prairie, in the north-west quarter of section 7, township 3, range 3. In a high part of the town, Mr. MARTIN struck sandstone at a depth of only ten feet, and some coal at thirty-eight feet. On lower ground, farther south, near the railroad, this coal has been found shallower; but still farther, in the south-west quarter of section 7, where the railroad company dug a well for making a tank, only slaty shales appear to have been penetrated, which would seem to underlie this coal. In boring deeper, coal is said to have been discovered there, at a depth of about one hundred and thirty feet, and of considerable thickness. Coal may have been found at that depth. Perhaps it was the same as at MARTIN'S digging, which is the East Fork seam, in which case the one in Mr. MARTIN'S well is a thin, higher seam; or else it may be a lower stratum; but it is certainly quite thin—too thin to be mined at that depth.

One and a half miles north of Alma, the East-Fork coal is again exposed on another prong of the creek, near Mr. B. HOWEL'S, in the south-west quarter of section 31, township 4, range 3. The coal is also dug from the bed of the creek, and I did not find it exposed. It is from fourteen to eighteen inches thick, and of very fair quality; contains little sulphur, and is preferred by blacksmiths, although it is soft and laminated, and the cuboidal pieces in which it breaks generally present the same dull appearance which is common to the other outcrops of this coal-seam. It has also been dug a little higher up the branch, but is said not to be so good there. Near by I noticed shales and shaly sandstones, and, at another point, black laminated slates, which form the roof of the coal, but only traces of the calcareous, fossiliferous slate. I observed, however, numerous large masses of a very impure limestone, which seems to be intercalated in the shales, and to overlie the coal, such as I found in township 3, range 4, at Hensley's coal-bank, north-east of Omega; and this outcrop is interesting, because it shows the connection between these so very different outcrops of the same coal-seam.

On another branch of the East Fork, a mile farther north-east, also near the edge of the high prairie, the coal is exposed again at the old Howel place, in the south-west quarter of section 29, township 4, range 3. At the head of this branch I noticed sandstones and shaly, arenaceous strata; then shales, and, finally, the coal, which is here from fifteen to seventeen inches thick, and rests on clay shale, and is capped by the black laminated slate; and at another point, only a few yards distant, by a shaly, rotten material, above which follow some ledges of the blue calcareous, highly fossiliferous slate, which has been mentioned so often. Near by I also noticed fragments of the impure limestone, with the shales above the slates and coal.

The same coal-seam has been found at several points on a more eastern prong of the same branch, especially at Mr. PRUET'S, in the south-east quarter of section 29, where the coal has been dug in the bed of the branch, and is reported as having been ten inches thick, of good quality. The black slate and traces of the calcareous slate were found there also. Lower down the branch, I observed some hard, strongly cemented calcareous sand-rock and soft sandstones. A good quarry might be opened near the center of this section. Shales and some sandstones are struck in wells at the edge of the prairie in the south part of section 21.

At Kinmundy, in the south-east quarter of section 22, township 4, range 3, sandstone is struck in all the wells from six to twelve feet below the surface, and they have to be dug from fifteen to thirty feet deep. The sandstones crop out at numerous points down the branch, in the north half of section 22, and are quarried in several places for building purposes. They are mostly soft, partly massive, some of them shaly, and some of them are hard and slightly calcareous. Towards the lower end of the branch, shales form its bank at several points, making the bottoms wet, and causing pools of stagnant water. All these rocks appear to be from a lower level than the coal-seam.

Further up the East Fork, I did not observe any more rocks in its banks in this county, except at a single point in the middle of the prairie, in the north-west corner of the south-west quarter of section 6, township 4, range 4, south-west of Farina Station. There, some of the calcareous sandstone crops out in the banks of the creek, and near by I noticed, together with drift boulders, a large slab of a limestone, which resembles the limestone above our coal-seam, and may indicate its presence in the adjoining hills.

More of the sandstones, limestone and coal was found on the east side of the prairie, on the waters of the Skillet Fork, which will be described below.

In my report on Clinton county, I have already discussed the formations on Crooked creek, near the county line and Central City, and have shown that they present the following succession of strata in descending order:

1. Shales partly arenaceous, with concretions of carbonate of iron, and with occasional layers of sandstone, at least thirty-five feet.
2. In their lower portion these shales contain an areno-calcareous layer, generally a hard calcareous sandstone, from one and a half to two and a half feet in thickness, with numerous fossils, *Productus*, *Myalina*, *Nautilus*, with some *Gasteropoda*, *Bryozoa*, etc.
3. A seam of coal ten or twelve inches thick.
4. Shales partly arenaceous, with some carbonate of iron, the kidney ore. At some points these contain, not far below the coal, some dark colored calcareous and arenaceous slates, with some fossils.

This section was obtained by examining the strata from an old mill-seat, half a mile west of the Clinton county line, on Crooked creek, to Central City, half a mile east of the county line. It bears some little resemblance to the one obtained from the examination of the strata on the east fork of Kaskaskia river, while we find that the strata some miles farther east correspond decidedly to those accompanying the coal-seam near the East Fork. Still, I am not satisfied that these strata near Central City are really lower in the series than the others; they may be the same with only a local variation in their development. The calcareous strata which we find with the coal-seam, vary considerably, and the difference between those near Central City and the East Fork, is hardly greater than that between different out crops of these strata on the East Fork, and at other points in the county. The observation of other coal-seams, teaches us that the rocks accompanying the same coal-bed, even at neighboring points, often vary to such a degree that one might be tempted to conclude that there were two or more distinct coal-beds, if their identity was not plainly evident to the dullest observer by other marks.

The calcareous sandstone, No. 2 of the above section, crops out in the bank of Crooked creek, near the county line. Farther up the creek, in the north-west quarter of section 6, township 1, range 1, the shales, No. 1, are variously exposed, and they also underlie Central City, on the south-east quarter of section 6. The sandstones interstratified with them are found tumbling near the creek, and have been quarried in the low uplands north-west and south-east of Central City, in the north-west quarter of section 6, and in the north-west quarter of section 8. They are partly soft, partly hard, bluish, and somewhat calcareous. In some places they are ripple-marked. Their aggregate thickness at these points is only a few feet.

At the ford north of Central City, just above the railroad bridge, the bed of the creek consists of fossiliferous calcareous shales; then follow three or four feet of argillaceous shales, and twelve inches of coal; and higher up the coal is also overlaid by shales. Areno-argillaceous, slaty shales form the bank of the creek, near the north-eastern edge of the town, in the north-west quarter of section 5, and on a branch farther north, in the west part of section 32, township 2, range 1.

Above the mouth of Raccoon creek, in the west part of section 4, a bluff on Crooked creek, about twenty feet high, consists of shales, with seams of sandstones. Farther on, still in section 4, near Meyers' old mill, the bank of Crooked creek presents fifteen feet of alternations of thin layers of shales, with equally thin layers of sandstone, each from one and a half to six inches in thickness; the uppermost layers of the sandstone thickening irregularly. Above these I observed large blocks of a calcareous slaty rock, or a highly-fossiliferous calcareous mudstone, which apparently takes the place of one of the calcareous strata in the above section, of No. 2 or of No. 4, and has slipped a few feet down from its original position. It reminds me strongly of the calcareous fossiliferous slate of the East Fork. Half a mile farther up, on the east side of section 4, and then also in section 3, the rocks are laid bare at several points on the south bank of the creek. They are more or less arenaceous and calcareous mudstones, some three feet thick, with numerous traces of fossils.

South of this point, on Raccoon creek, the same strata are exposed. The first outcrop above its junction with Crooked creek, in the north-east quarter of section 8, consists of arenaceous shaly layers. Then, in the north-west quarter of section 9, at a bend on the north side of the creek, and a few feet above the water level, the calcareous mudstone, or slaty limestone, is again exposed, at least eighteen to twenty-four inches thick, with numerous *Productus*, *Bellerophon*, and other fossils. Farther on, toward the center of section 9, it still holds the same position, and it continues exposed along the creek—partly in place, partly tumbling—through the east part of section 9 and the west part of section 10, overlaid with dark argillaceous slates and shales.

On a small branch on the south side of Raccoon creek, at Snyder's quarry, in the south-east part of section 9, we find the next higher strata; first, four inches of black slate, then six inches of stone-coal; above that twenty feet of sandstone, and then shaly, arenaceous strata, which latter are also struck in wells nearly at the edge of the Nine-mile prairie. The sandstone forms heavy beds, and, when freshly quarried, it is bluish-gray, but after long-continued exposure it often turns yellowish-brown. Some of it is slightly calcareous, but most of it is purely arenaceous. It is well adapted for building purposes, and dresses well, although some portions are harder than others. On its horizontal partings we find much mica, and traces of vegetable substances. It apparently corresponds to No. 1 of the above section, but is more purely sandy. The coal, then, corresponds to the seam at Central City, in the bank of Crooked creek. Although it is not thick enough to be mined alone, it is saved in the quarry and sold at Centralia.

Farther up Raccoon creek I only noticed a few layers of sandstone in its bank, in the south part of the north-west quarter of section 14, township 1, range 1; and then, for several miles, no rock at all, except a few tumbling sandstones near the bend of the creek, close to the line between range 1 and range 2.

Central City occupies the south-east quarter of section 6, township 1, range 1. At the north side of the town, only a short distance south of the creek, a shaft was sunk in 1857. No detailed record has been kept, and the statements which I have been able to obtain in relation to the undertaking are meagre and unsatisfactory, and those of different persons do not agree fully. The following appears to be reliable: The shales, No. 1 of the above section, were struck at a depth of fifteen feet, and continued thirty-five feet, with an intercalation of eighteen or twenty-four inches of the fossiliferous, calcareous sandstone, No. 2. Then, at a depth of fifty feet, ten inches of coal was found, the same which crops out at the ford near by; after that, principally shales, which were partly arenaceous, and some shaly sandstones and concretions of carbonate of iron. At a depth of ninety feet another bed of hard rock was struck, apparently also a calcareous sandstone, and then more shales and the like. At a depth of one hundred and ten feet sandstone was found, and at one hundred and eighty feet a second seam of coal, twelve inches thick. One account says that some feet above this coal a foot of limestone was penetrated; while one of the laborers who worked in the shaft assured me that, about thirteen or sixteen feet above the coal, say one hundred and sixty-six feet below the surface, four feet of hard blue limestone occurred. If he is correct, this limestone would appear to correspond to the Shoal-creek limestone of the Clinton county report, which is further made probable by the report of the boring at the machine-shops of the Illinois Central Railroad, at Centralia, of which I will speak below.

Ten feet below the coal, at a depth of one hundred and ninety feet, the sinking was discontinued, and they bored one hundred and eight feet deeper, to a depth of two hundred and ninety-eight feet, when a weak brine was struck, which rose in the hole to seventeen feet above the bottom of the shaft. The undertakers then abandoned the work, thinking that they had penetrated through the whole of the Coal Measures to the lower formations. This idea is certainly unfounded. In the first place, we know from our examinations farther west and south that the strata in this vicinity are high up in the Coal Measure series, several hundred feet above the horizon of the DuQuoin and Belleville coals. Further, all the strata which were penetrated are exactly such as we would expect to find in this upper division of the Coal Measures, and decidedly different from those of the underlying formations, which we would expect to find composed principally of heavy masses of limestone, or perhaps thick bodies of sandstone. Nevertheless, the boring might have come, at its lower end, to a protruding body of the lower formations, and the lower portion of the Coal Measures might be wanting here; but this conflicts with the results obtained at Centralia, only two miles farther south, where a boring was carried to a far greater depth, and coal was still struck over six hundred feet deep. The mere presence of salt water does not by any means prove that the Coal Measures have been entirely passed through, and I am most decidedly of the opinion that it has not been done. The brine may originate within the Coal Measures, or, more probably, in the Lower Carboniferous formation, from which it may have risen in a fissure, or water-vein, into the higher strata in which it has been struck. This is more probable, because it is reported to have been weak, apparently mixed considerably with fresh water. Unluckily, the shaft is not any longer accessible, or else it would be interesting and important to make further examinations.

Centralia is situated a short distance south of Central City, principally in section 18, but extending into sections 7, 17 and 19, of township 1, range 1. The Illinois Central Railroad depot and machine-shops are south-west of the center of section 18. In many wells in the town, water is obtained in quicksand, while shales are struck in all deeper ones at twenty feet or more. These shales are very finely arenaceous, micaceous and slaty. The railroad company tried to obtain water by an artesian well, and bored, for that purpose, at their machine-shops, a six-inch hole, to a depth of eight hundred and sixty-four feet, in 1857 and 1858, without, however, succeeding in their object. If all possible care had been taken to obtain, at the same time, a correct account of the strata which were passed through, such a record would be of inestimable value in settling some pending questions in relation to the geology of this part of the State, and of direct benefit to the company in determining the prospects for opening coal-mines along their road. Sufficient attention, however, seems not to have been paid in determining the thickness and quality of every stratum. A journal has been kept, which must contain some valuable data. I was informed that it was packed away with other old documents of the company, and I was unable to gain access to it.*

South of the Nine-mile prairie, in which Centralia is situated, toward the Jefferson county line, and in the south-east part of this prairie itself, sandstones and shales have been found at various points. In sections 31 and 32, township 1, range 1, and also beyond the county line in this vicinity, sandstones have been occasionally quarried at several points. They are mostly purely arenaceous, but partly calcareous and very hard; and, besides, we find some shales. On the upper course of a branch of Grand-point creek, in the north-east

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* For the following section of this boring, we are indebted to Mr. THOMAS TIJOU, of Wall's colliery, at DuQuoin. How much reliance is to be placed on the reported thickness and character of the beds passed through, we cannot say; but from the fact that the railroad company have made no effort to open up the six-foot seam of coal, reported to be only two hundred and sixteen feet below the surface, it would seem that they did not rely fully on the truthfulness of the statements made by those who were placed in charge of this important work. But the recent discovery of coal in the boring at Xenia, in Clay county, at a depth of only two hundred and fifty feet, renders the report of this boring the more probable, and if the Belleville coal was found here at all it would probably not be much more than three hundred feet below the surface.

A. H. W.

| | | FT. | IN. | | FT. | IN. |
|---|---|---|---|---|---|---|
| Blue clay, yellow sand, etc. | Thickness, | 20 | 6 | Total depth, | 20 | 6 |
| Sandstone | | 1 | 10 | | 22 | 4 |
| Blue slate, light color | | 10 | — | | 32 | 4 |
| Blue slate, dark color | | 55 | 8 | | 88 | — |
| Bituminous shale | | — | 8 | | 88 | 8 |
| Hard blue clay, mixed with gravel | | 3 | 6 | | 92 | 2 |
| Blue shale (slate) | | 25 | 6 | | 117 | 8 |
| Soapstone (probably indurated clay) | | 91 | 4 | | 209 | — |
| Limestone | | 7 | — | | 216 | — |
| Bituminous coal | | 6 | — | | 222 | — |
| Soapstone | | 12 | — | | 234 | — |
| Lime rock | | 6 | — | | 240 | — |
| Soapstone | | 93 | 6 | | 333 | 6 |
| Bituminous shale | | 2 | — | | 335 | 6 |
| Coal | | 3 | — | | 338 | 6 |
| Limestone | | 20 | — | | 358 | 6 |
| Soapstone | | 151 | — | | 509 | 6 |
| Sandstone | | 25 | — | | 534 | 6 |
| Black slate | | 6 | 6 | | 541 | — |
| Soapstone | | 65 | — | | 606 | — |
| Iron stone, very hard | | 3 | 6 | | 609 | 6 |
| Soapstone | | 247 | 6 | | 857 | — |

quarter of section 32, (?), I observed some slaty shales, with a thin impurely calcareous layer. Sandstones have been struck in several wells on the south side of the prairie, especially on elevated prairie hills—for example, in the south-east quarter of section 28, and farther west. On a shallow prairie ravine, in the north-west quarter of section 27, arenaceous shales and some sandstones are exposed, and also on another branch in the east part of section 26. In the timber east of the prairie, I noticed a large mass of the hard, bluish, calcareous sandstone, near a branch of Raccoon creek, in the east part of section 25. The whole country is evidently underlaid with this formation.

Thence east, we come to a district in which coal has again been observed at numerous points. Near the range line, in the north-east quarter of section 36, township 1, range 1, north-east of Walnut Hill, in a ravine at the edge of the high prairie, arenaceous shales and thin layers of sandstone are exposed. Some of this sandstone is good for building purposes, although in thin layers. A short distance down that branch, near the north-east corner of section 36, we find a seam of coal, apparently only eight or nine inches thick, free from slate, and capped directly by shales. It is known as Marc. Cameron's seam, and has been used occasionally for blacksmithing. From the following it will appear that this coal-seam is the same which we have found on the East Fork, in township 3, range 1, and at other points, although here the usually accompanying calcareous rocks and slates do not appear to be developed.

Three-quarters of a mile farther east, near ANDREW COBBEL'S place, a quarter of a mile west of the north-east corner of section 31, township 1, range 2, I found the same sandstone strewn in the breaks, and the coal exposed in a ravine not far below the summit level. It has been dug here to a limited extent, as it is of good quality, although it is only from eight to ten inches thick. In some places the shales cap the coal directly; at others, I observed the highly-fossiliferous black calcareous slate above it, which we recognize at once as the roof-slate of the coal on the East Fork. Limestone has been burnt close by, either from points where the calcareous slate has changed into limestone, as we frequently find it in connection with this coal-seam, or, possibly, from a calcareous layer which may exist a few feet below the coal, and corresponds to similar but less purely calcareous layers below the coal on the East Fork. This same limestone occurs also at other points in the vicinity, and I observed a ledge of it on the slope south of Raccoon creek, in the middle of section 29, where it is of a whitish color, and full of indistinct fossil remains.

The coal has also been struck in a well close to the county road, on the west side of section 28; but I could not learn the particulars. Sandstone crops out on the branch a short distance east of this, and on Raccoon creek sandstone and shales, apparently lower than the coal, are exposed in the east part of section 29; while, farther down the creek, for miles, no rocks crop out in its banks. Up the creek, in the north part of section 28, I also noticed shales and some sandstones, and above them, traces of the coal. There I also observed masses of a calcareous mudstone, such as I had seen near Central City and on the East Fork, which here contains some carbonaceous substance and curious petrifactions, apparently of roots of coal-plants, which may, however, be of animal origin.

At the great bend of the creek, in the north-west quarter of section 27, sandstones occur—partly shaly, partly firmly cemented—overlaid with shales; and above them the coal is capped with the black slate; but the coal was not sufficiently exposed to determine its thickness. Near by, I noticed tumbling pieces of a hard calcareous sandstone, with fossils. Sandstones of various qualities, soft or hard and calcareous, are found at various points through section 22.

In the north-east quarter of section 22, the coal has been dug in the bed of the creek at various points, a quarter of a mile west of the Salem and Mount Vernon road. This place is known as Mercer's diggings. All the holes were full of water, so that I could not see the coal in place. It is said to have measured from twenty to twenty-four inches in thickness. The top coal appears to have been slaty, while the lower part of the coal was firm and good. It is overlaid with black laminated slate, most of which is pure, while some of it is calcareous and highly fossiliferous, and changes at some points to a limestone. In this slate I noticed some lumps of iron pyrites; but the coal seems to have been rather free from it. Above the slate, follow shales, with some iron ore and then sandstone.

The same coal has been dug to some extent on a branch a short distance south of the creek, south of the center of section 22, where the roof consisted of the black laminated slate. I noticed there, also, traces of a conglomeratic layer, which I found more developed some miles farther north, near the same coal-bed.

The coal is reported to have been found, also, in digging a well north of Racoon creek, at the southern edge of the Tennessee prairie, near the middle of the east line of section 20, at a depth of eighteen feet, and said to be two feet thick.

Higher up Raccoon creek, sandstone (apparently the higher one) crops out at the crossing of the Mt. Vernon and Salem road, on the east line of section 22, and again, a quarter of a mile farther up, in the north-west quarter of section 23. Then, no more rocks are exposed on the creek, to its head. South of the creek, the upper sandstones are noticed in the breaks near the meeting-house of the Covenanters, east of the center of section 33, township 1, range 2; and shales were struck in a well near the county line, on the post-oak flat, near the south-west corner of section 35, and in the little prairie east of the center of section 26.

Farther north, sandstone, apparently that above the coal, has been struck in several wells, at a depth of from twelve to twenty-five feet, at the north-western edge of the southern arm of Romine prairie, in the south-west quarter of section 11, or the north-west quarter of section 14, and in the south-west quarter of section 2, township 1, range 2. It has never been penetrated more than a few feet. Undoubtedly, shales and coal would be found underneath it.

West from there, at the north-eastern edge of Tennessee prairie, the same coal-seam has again been discovered, at Mr. JAMES J. RICHARDSON'S, in the north-west corner of section 9, township 1, range 2, extending, evidently, under the adjoining lands. The coal has there been dug, to some extent, in the bank of a small ravine, and in a shallow shaft. It is from eighteen to twenty-two inches thick, and of fair quality. It contains little sulphuret of iron, but some of the fibrous, or so-called mineral charcoal. The horizontal lamination and vertical partings are strongly developed. Below the coal is a hard rock, of what kind, I could not ascertain; probably, a calcareous sandstone. In the shaft, the roof of the coal consisted of three feet of black slate, which was partly calcareous and full of fossils, but there was no limestones. Higher up, followed gray shales, with some concretions of carbonate of iron. On the ravine near the shaft, however, as much as eight feet of slaty gray limestone is exposed above the slate, which is there much thinner. Between it and the limestone, which is divided into large, square blocks, a mixed, shaly areno-calcareous layer is intercalated.

The coal has also been found at several points south of Crooked creek, in sections 33 and 34, township 2, range 2. It has been dug on a ravine at the edge of a little prairie, near Mr. S. HOFF'S place, in and near the north-east corner of the south-west quarter of section 34. The highest rock there is a soft sandstone, of which about four feet are exposed. Then follows only a few inches of shale, then twenty inches of black laminated slate, and from twelve to fourteen inches, and at one place twenty inches of coal, which is apparently of good quality. In the black slate I noticed some concretions of iron-pyrites. At some points it becomes calcareous, and is then either full of calcareous fossils, or contains heavy concretions of limestone, or even an irregular bed of the same material.

The coal is also exposed on a ravine in the north-west corner of section 34, and in the north-west quarter of section 33, and has been worked on Mr. SANDERS' place, in the north-east quarter of section 33, in a ravine at the edge of a post-oak flat. Here the upper sandstone is again harder, and encloses in its lower part many carbonaceous particles and impressions of coal-plants. Its lower one or two feet are, in some of the diggings, mainly composed of ferruginous, or calcareous nodules, and irregular streaks of slate, so that it assumes a curious conglomeratic appearance, traces of which I had before noticed near Raccoon creek, in section 22, township 1, range 2. The shales below the sandstone are here hardly represented. Then follow the slates, which at some points are three feet thick, at others, hardly one foot. As they decay rapidly, the fossils can not be readily preserved, except when they are taken from newly dug slate. Of solid limestone, I saw here only traces. The coal below the slate has the same thickness and quality as at HOFF'S.

Following down the ravine to Crooked creek, and down the latter, I find in the south-west quarter of section 28, township 2, range 2, several out-crops of sandstone and abandoned quarries, and a large quarry is now worked on its bank, in the south-east quarter of section 29. The quarry rock is there twenty-five or thirty feet above the creek, rather soft, finely grained, and a little micaceous. It is only a few feet thick, while most of the strata above and below it appear to be shaly. Down the creek we can trace these sandstones into section 31, although they are little exposed. No traces of the coal or slate were observed, nor any rocks, farther down for several miles, except drift boulders and some tumbling pieces of the fossiliferous, more or less calcareous sandstone. On Crooked creek, above section 28, no rocks have been discovered in place to its very head, nor on its branches, although they extend east of Salem, and head near Alma.

Salem is situated in section 11, township 2, range 2, near one of the branches of Crooked Creek, at the edge of the prairie. Water is obtained there in shallow wells, and no rocks have been struck in digging.

At the west edge of Romine prairie, near the Salem and Fairfield road, in the east part of section 32, township 2, range 3, shales have been struck in a well, while most wells in this vicinity pass only through Quaternary deposits. North and east from there, however, on a high prairie ridge, in the south-east quarter of section 29, and in section 33, and, probably, also father south, sandstone has been struck in wells at a small depth. On a high point of this ridge, in the south-eastern part of the prairie, near the middle of the east line of section 16, township 1, range 3, at the head of a ravine, several feet of a strongly cemented, hard calcareous sandstone crops out, which is inclined to be shelly, and can not be dressed. Near the southern edge of the prairie, sandstone has been struck in many wells. In the south-east quarter of section 22, township 1, range 3, it is from five to fifteen feet below the surface, and so also in the south-east quarter of section 21, and farther west, near the middle of the north line of section 29, and in the south-east quarter of section 30.

South of Romine prairie, sandstones crop out on a branch of Big Muddy river, in the south part of section 32, township 1, range 3, near the county line; and also at various points in the timbered hills farther east, where sandstones or shales are generally found within a few feet of the surface. In this vicinity, north-west of the center of section 33, some coal has been discovered on a small branch. There, at the head of the breaks, I found sandstone; and lower down, a ledge of the hard, strongly-cemented sand-rock, which appears to change into a rock of a conglomeratic appearance, such as was observed at Sanders' coal-bank, near Crooked creek, and at one point here it is two feet thick. Then follows a little shale, a mere trace of slate, and then the coal. It is said to have been found at one point nine inches thick; but is not now exposed there. Close by, I noticed two inches of coal, which seemed to be, however, a few feet higher than the main seam. Some fragments of the coal, strewn about there, differ in appearance from the coal of the other diggings. It is hard, somewhat slaty, with sub-conchoidal fracture, like an impure, very slaty cannel-coal, and heavy from a large amount of earthy matter. There also seems to be considerable pyrites, and a small chalybeate spring issues near the coal. I could not fully satisfy myself whether this is the continuation of the coal-bed of the East Fork and Raccoon creek, although I suppose it is. Sandstone seems to be much stronger developed, and to prevail over the other rocks in the south-eastern part of the county, although the formation is still the same as farther west.

On Horse creek, in the south-east part of township 1, range 3, between Romine and Donnehue prairie, sandstone crops out at a few points, and the hills are underlaid with it; but the banks of the creek are generally formed of high alluvial clay-banks, and show only tumbling rocks.

At the eastern edge of Romine prairie, on the waters of Fulton branch of Skillet Fork, coal has been discovered at several points. North-east of the center of section 10, township 1, range 3, sandstone crops out at the head of a branch of this creek, the lower portion of which presents a conglomeratic appearance, it being formed of a mixture of sand, lime, nodules of brown oxyd of iron, and flint pebbles, with traces of fossils and particles of carbon. Lower down the branch, some black slate was exposed, and below it gray shale. Some fragments of a slaty coal were also noticed, but it is not exposed in place here.

It has been discovered a mile farther down the branch, which runs near the edge of the prairie, near Mr. WILLIAM HILL's place, in the north-west quarter of section 2. There it has been laid bare on a hillside, and has been dug into, also, on the south side of the creek. It was evidently only a few inches thick, with only a little slate above it, and capped with arenaceous, shaly rocks. In the bank of the creek, a few feet below the coal, some sandstone crops out, which is finely adapted for building purposes. A quarter of a mile farther north-west the coal has again been dug into, but with no better result.

Farther north, on another branch of Fulton creek, in the north part of section 34, township 2, range 3, sandstones are prominently exposed at the edge of the prairie, and I noticed in them, at one point in the face of a bluff, a small pocket of coal, about two feet long by four inches thick at the thickest. I am told, however, that near by some six inches of coal crops out, and forms a regular layer. In these instances I am at a loss to determine whether this coal forms the continuation of the East Fork coal or not, although I am rather inclined to think that it does. East, north-east and south-east from there no further signs of coal have been discovered in this county.

Down Fulton creek to its mouth, outcrops of rock are quite scarce, but sandstones and shales were noticed at a few points in its banks; and the flats and barrens north and south of it are underlaid with these same rocks, which have been observed at various points.

On the upper course of the branches of Fulton creek, at the south side of the Middleton prairie, sandstone is very largely exposed in the south-east quarter of section 27, and in the south part of sections 23 and 24, township 2, range 3, and farther east, on the branches south of Middleton, on the east side of section 19, township 2, range 4. These rocks are partly soft and rather massive in their structure, and at some points they crumble so easily to sand that they are hauled away for plastering.

In the prairie north from there the sandstone has been struck in many wells in the east part of section 15, in the south-east quarter of section 14, in the south-west quarter of section 13, township 2, range 3; also at New Middleton, in the north-west quarter of section 17, township 2, range 4, and at other points. The wells here frequently pass forty feet deep through more or less pure sandstones, which begin not more than ten or fifteen feet below the surface.

On the small branch of the Skillet Fork, north of Middleton, this sandstone is exposed continuously for about two miles, in the south-west quarter of section 7, and in the south part of sections 8 and 9, township 2, range 4. It is partly soft and massive, partly harder and more thinly stratified. The cliffs along the branch become higher as the stream descends eastward. They are at many points twenty-five or thirty feet high from the water's edge; and the aggregate thickness of the sandstone, without any shales, must be fifty feet or more. At its lower end, intercalations of shales make their appearance; then the outcrops are farther apart; and finally, in the middle of the south half of section 9, the last exposure on the branch consists of shales. The uplands in this vicinity, and also on the other side of the Skillet Fork, near the former town site of Fredericktown, in the center of section 11, and on the west and south sides of Ramsey's prairie, and north toward Conner's prairie, are all underlaid with these sandstones, although they are very sparingly exposed.

On Skillet Fork no rocks are exposed for several miles above the Ohio and Mississippi Railroad, and for over a mile and a half below it. The first exposures south of the railroad are found in the south-west quarter of section 22, township 2, range 4, where about ten feet of rather massive sandstones outcrop at the water's edge. Thence down for about a mile there are several similar exposures, the last one in the south-east quarter of section 28; and also some prominent sandstone cliffs, on a little branch on the east side of the Skillet Fork, known as the Rock-house branch. The next rocky bluff is found two miles farther south, in the south-east quarter of section 3, township 1, range 4. It is similar to the first one, but higher, and somewhat shaly at its base, while more sandstones crop out higher up in the hills. It extends, along the west bank of the creek, to Songer's mill, which is close to the south line of the section, where it shows alternations of sandstone with much shale, and for about a mile beyond, through the west half of section 11.

A mile farther on we find another outcrop of sandstone at the water's edge, close to the mouth of Paint-rock creek, in the north-west quarter of section 22. Then there are generally bottoms on both sides of the creek, and the sandstone is only exposed farther off in the hills, except in the north-west quarter of section 26, where it again crops out in the bed of the creek. In the south-east corner of the county the same rock forms several prominent cliffs on the south-west side of the creek; at the mouth of Branson's branch, near the middle of the west line of section 36, township 1, range 4, where it forms a vertical cliff twenty-five feet high from the water's edge, with more of it in the sloping summit of the hill; and on the east side of that section, near the county line, another, the so-called Beech bluff.

West from this, toward Donnehue prairie, in the south part of township 1, range 4, the sandstones crop out at various points on Branson's branch, and in the barrens; and they are prominently exposed at the head of a branch of Paint-rock creek, at the north-east corner of Donnehue prairie, in the north-west quarter of section 29, or in the north-east corner of section 30. Along Paint-rock creek (which takes its name from lumps of sulphuret of iron which are occasionally found on it, and in their decomposed state are used by the farmers for dyeing), the sandstones likewise form numerous cliffs and smaller outcrops, in sections 21, 20, 17, 18, and at some points higher up toward Romine prairie. This whole formation is apparently below the coal-seam of Raccoon creek and the East Fork.

Dom's creek heads about three miles east of Alma, in the north part of township 3, range 3; then runs south to near the Ohio and Mississippi Railroad, and then turns east into the Skillet Fork, in the east part of section 10, township 2, range 4, a short distance north of the railroad bridge. For over a mile above its mouth no rocks crop out in its banks; and the first ones seen are some sandstones in the middle of section 4. Then I noticed several exposures of shales, with concretions of carbonate of iron, overlaid with sandstones, in section 5. Some miles farther west, at and below the bend of the creek, sandstones are also exposed in its bank, and have been quarried to advantage in the south-east quarter of section 10, and all through section 11, township 2, range 3, and perhaps farther down.

Below the bend sandstones are also largely developed in the adjoining hills. They have been quarried in the Tadlock branch, in the east part of section 2, and crop out, together with arenaceous shales, near the county road, in the east part of section 11 or west part of section 12. A short distance above the bend gray shales form the bank of the creek, at an old mill-seat in the north-east quarter of section 10; but thence upward very few rocks have been discovered along it. The next are on a small branch west of Dom's creek, in the south-east corner of section 33, township 3, range 3. They are likewise sandstones, rather hard and irregularly stratified. These, together with shales, have also been struck in digging wells in this vicinity. Near the middle of the adjoining section (34), some sandstone is said to be exposed in the bank of the creek; and farther up, at the bridge near the north line of the north-west quarter of section 35, I found, in the bed of the creek, some shales, overlaid with two inches of an impure limestone, full of fossils—*Myalina*, *Gasteropoda*, stems of *Crinoidea*, etc.—while above it lay heavy blocks of a similar limestone, which had evidently been once in place in the higher part of the bank. This is undoubtedly the same bed of rock which I afterwards found north-east on Bee branch, and at other points, corresponding to similar limestones in the vicinity of Raccoon creek, which are there closely connected with the coal-seam, generally above it, but others in some places below it. Thence up for several miles no outcrops whatever occur on Dom's creek, except near its head; but shales and shaly sandstones have been struck in several wells in the prairie west of the creek, in the south part of section 27, township 3, range 3, from fifteen to twenty-five feet below the surface, and in a well near the middle of the west line of section 27 (?), on land belonging to Mr. WARNER, sandstone is reported to have been struck at less than twenty feet, and underneath it some inches of stone-coal.

On the upper course of Dom's creek, east of Alma, near the middle of the west side of section 10, township 3, range 3, the East Fork and Raccoon creek, coal has been discovered and dug into near Mr. WILSON'S. The coal has been dug in the bed of the creek, and is reported to have been from eight to ten inches thick, and of good quality. Fragments of the black slate and of the coal were lying about, which presented the ordinary appearance of the East Fork coal.

East of Dom's creek, at the upper end of Red-lick prairie, above the head of Bee branch, in the middle of section 13, township 3, range 3, shales, with concretions of carbonate of iron, were struck, at a depth of only ten feet. On Bee branch, on both sides of the range line, near the south-east corner of section 13, several feet of bluish shales crop out, capped by four inches of a limestone, which is dark red, or, at other points, red, from the oxydation of iron, and contains fossils. Some feet below the limestone, the shales turn to a dark blue slate, which has been dug into; and I have been informed that some coal had been obtained there, but I could not fully satisfy myself in regard to it. At any rate, the coal must have been thin. The rocks dip toward the south-east, down the branch. At the head of the next prong of the branch, farther south, we find some sandstone and shales, which apparently overlie the above mentioned strata, of which no trace is to be found here. A few rods down the branch, in the north-west quarter of section 19, township 3, range 4, gray, somewhat arenaceous shales, with kidney iron-ore, are exposed, and continue some distance. Still farther, in the south-west quarter of section 19, limestones crop out in the bank of the creek, underlaid with some arenaceous shales and shaly sandstones, and continue more or less exposed to near the north line of section 30 (?). These limestones are several feet thick, of grayish color, hard and impure, apparently considerably mixed with mud, and thus analogous to the calcareous mud-stones in other parts of the county. They evidently correspond to the above mentioned limestone on Dom's creek, and to that at Hensley's coal-bank, three miles farther north-east, and it would seem probable that they also form the continuation of the four inches of limestone at the head of Bee branch, which is perhaps their lowest layer. In section 30, these rocks disappear, probably rising to a higher elevation, and along the creek we then find arenaceous and argillaceous shales, overlaid with some heavy layers of sandstone, some of which are good for building-stone. Similar rocks are still exposed in the north-east quarter of section 31, but thence down to its junction with Dom's creek, no more outcrops of any kind are found on this branch. Tumbling pieces of limestone similar to that on the creek, together with sandstones, were observed at various points on the slopes west of the creek, at the edge of Red-lick prairie, from section 24, township 3, range 3, not far south of the head of the creek, to the north part of section 31, township 3, range 4, near the south-east corner of the prairie.

Farther east, hardly half a mile south of Omega, near the middle of the south half of section 17, township 3, range 4, at the head of a ravine, the bank consists of arenaceous shales, while a few yards lower down, I observed large slabs of a red limestone, the same layer which I had noticed at the head of Bee branch.

East from there, on both sides of the Skillet Fork, only sandstones and shales were discovered, the same as on the lower course of Bee branch, which underlie the limestone and the East Fork coal-seam. In the timber near the south-east end of Lowell prairie, especially in the south-west quarter of section 27, township 3, range 4, sandstones crop out on some ravines, and in a well dug in the south-east quarter of section 27, near the bank of the Skillet Fork, shales were struck, with concretions of carbonate of iron. No outcrops of rocks have, however, been observed on that stream from below the railroad to near Critchfield prairie, a considerable distance above the mouth of the Lost Fork. At several points it runs past high and steep banks, but these consist of alluvial clay, with only a few tumbling rocks and drift boulders. The only rocks observed east of the Skillet Fork in this vicinity are some sandstones in a ravine near the west side of Conner's prairie, on section 25, which have also been struck in some of the wells of that prairie; and then some sandstones and arenaceous shales on Conner's branch, within half a mile of the county line, near the middle of the south line of section 36, township 3, range 4, and in the hills north and south of that branch, in sections 1 and 36.

On the Lost Fork, a quarter of a mile above its junction with the Skillet Fork, in the south-east quarter of section 22, township 3, range 4, I observed shales, with iron-ore in the lower part of the bank, and close by, some twenty-five feet above low-water, several feet of sandstone, of good quality for building purposes. Similar sandstones crop out farther up the creek, especially in the south-west quarter of section 10, and farther toward its head and on its branches, also near the edge of Lowell prairie, near the north-west corner of section 22, near the middle of the north line of section 16, and at other points.

In the north-west quarter of section 9, township 3, range 4, on a branch of Lost Fork, not far from the edge of the prairie, is Hènsley's lime quarry and coal mine. The branches and lower part of the hills here exhibit numerous outcrops of arenaceous shaly strata, with some intercalated ledges of fine sandstone, which extend, also, up the branch, into the south part of section 5, and up the main creek through section 4, and far beyond. In the south-east quarter of section 32, township 4, range 4, sandstone has been quarried from this bed for building culverts on the Illinois Central Railroad, near Kinmundy. Above these strata at Hensley's, there is a little clay-shale, then a thin parting of slate, and a layer of stone-coal, which is about ten inches thick, of which eight inches is good coal, and then limestone in heavy blocks, which is fully five feet thick, where it is well developed. The coal is somewhat rotten at the outcrop, but better where it has a heavier cover. It is precisely of the same general character as the coal from the East Fork; is inclined to laminate; rather free of sulphuret of iron, and is advantageously used in an adjoining smith-shop. The limestone is very hard, of a grayish color, and quite impure It can be burned, but makes a gray lime, which is, nevertheless, extensively used in the neighborhood, lime being scarce. This limestone is not quite as impure as that on Bee branch, which is evidently the same stratum, although the coal has not been discovered there. There can be hardly a doubt about its also forming the continuation of the limestone which we have repeatedly observed on the west side of the prairie, north of Alma, and again near Raccoon creek, and at other points above the East Fork coal-seam, which at other localities is represented merely by irregular concretions of calcareous matter, or by a large admixture of the same to the roof-slate of the coal-seam. The coal can be profitably worked at this locality only in connection with the limestone quarry, and is most convenient for burning the lime. This limestone and coal crop out again on the other side of the hill, near the center of section 9, and the limestone, also, at Mr. JOSEPH LEWIS', in the north-east quarter of section 8, where the coal is not exposed.

Farther south-east, the underlying sandstone and shales alone appear to be found, except at a single place, in a ravine, on the east side of Lost Fork, in the south part of section 15, where the limestone is said to occur in tumbling masses, and to have been burnt some years ago. Farther north-east, I observed some tumbling blocks of apparently the same limestone, on the road north of Omega, near the south-west corner of section 5, which indicate the presence of these strata in the hills of this county. Again, two miles south of east of Kinmundy, near the head of one of the branches of the Lost Fork, on the east side of the prairie, in the north-east quarter of section 23, township 4, range 3, similar limestones protrude in such quantity from the sloping bank, that I am satisfied they range through here underground; the more so, because the limestone and coal were not only observed some miles west from there, on the branches of the East Fork, but also farther east, on the branches of the Skillet Fork. At that point, in section 25, the limestones are partly rather pure, partly highly arenaceous, even exhibiting a change into a flinty calcareous sandstone. Below them, in the branch, shaly arenaceous strata are largely exposed. No trace of the coal has here been observed, but it would most likely be found, if search was made for it, by digging at the proper point.

A very curious exposure was observed on the east bank of the Lost Fork, in the north-west quarter of section 32, township 4, range 4. Shaly sandstones and arenaceous shales are variously exposed on the creek in that vicinity. At the point in question, on Mr. GRIGG's place, fifteen or twenty feet of such strata form the base of the hill, with an irregular seam of coal in the lower portion, which varies between three and ten inches in thickness. There is no slate with the coal; but in places the shale next above the coal contains thin shells of limestone, and the coal-seam itself incloses more or less calcareous masses, which, upon examination, proved to be mainly composed of the same curious fossils which I had observed before, in the horizon of the coal-seam on Raccoon creek, and which is either of coralline origin, or some petrified vegetation. I am not fully satisfied whether this coal-seam is the continuation of Hensley's and the East Fork seam, but think it highly probable.

Near the Clay county line, on the south and south-east side of Critchfield prairie, the first rocks are again found on the Skillet Fork, which for miles below that point, runs between banks of clay. First, near the south end of the prairie, we find tumbling sandstones in the slopes; then, in the south-east corner of section 12, township 3, range 4, near the south-east corner of section 1, and at other points we observe in the banks of the creek and on the ravines, solid layers of sandstone, with shaly strata, as on the lower course of the Lost Fork. Near the center of the south-east quarter of section 36, township 4, range 4, not far from Mr. LUTTEREL's, I observed at the water's edge an outcrop of limestone, which presents an exposed thickness of more than two feet, of grayish color, partly soft enough to be burned, partly hard and silicious. Above it, follow four feet of black laminated slate, which changes upward into shale. Mr. LUTTEREL informs me that, digging in the bed of the creek, he came to coal about three feet below the lower exposed edge of the limestone. A little farther down the creek the shale and slate again form the bank, with some limestone at the water's edge. Some coal, apparently identical with the East Fork coal, was noticed there, which seemed to have been dug up at this point; but I could obiain no additional information.

On a small branch of the Skillet Fork, north of Critchfield prairie, in the north-east quarter of section 26, township 4, range 4, I found several feet of argillaceous shales, and above them a few inches of coal, which is rotten at the outcrop, and has not been dug into, so that its thickness and quality can not be determined positively. It appears to be quite thin. Then follow several feet of dark-blue slates, and some tumbling pieces of limestone, which latter was not observed in place in this vicinity. The whole reminded me strongly of the outcrop on the Lost Fork, three and a half miles farther west. North from there, near the edge of Grand prairie, in sections 23 and 14, I observed at various points shales and sandstones, some of which are a very good building material. All the above enumerated exposures of coal and limestone near the Skillet Fork would seem to be outcrops of the same strata, and moreover, to form the continuation of the East Fork coal and the strata connected with it, although they differ from them in their local development.

## *Economical Geology.*

*Stone-coal.*—I have already stated that the geological formation of this county comprises only an upper division of the Coal Measures, and that there are, therefore, prospects for coal not only in the strata nearest to the surface, but also at a greater depth. The foregoing description of all the outcrops in different portions of the county, shows that the larger portion of the county is underlaid at a small depth with a seam of stone-coal, the thickness of which varies from a few inches to two feet, and the quality of which is in most instances very fair. This coal-seam may be worked profitably at numerous points for supplying the local demand, especially where it can be stripped along its outcrops, and even by regular mining operations, where it is thickest. The following table contains an enumeration of all places where this coal has been discovered, with its thickness at each point where it could be ascertained:

| Number... | Name. | Township... | Range... | Section... | Quarter | Thickness. *Inches.* | Remarks. |
|---|---|---|---|---|---|---|---|
| | Casey's mill........... | 3 | 1 W | .... | In Clinton Co. | 12 | On East Fork, half a mile west of the county line; is the same as the following. |
| 1 | Hawkins.............. | 3 | 1 E | 10 | Center ....... | ............ | In a well north of East Fork. |
| 2 | On East Fork......... | 3 | 1 | 12 | Middle....... | 18 | At the mouth of Jim creek. |
| 3 | On Jim creek......... | 3 | 1 | 12 | Middle....... | 18 | Close to East Fork. |
| 4 | ...................... | 4 | 2 | 32 | Middle S. line | ............ | South of East Fork. |
| 5 | Smith's ............... | 4 | 2 | 33 | N. E. corner.. | ............ | On East Fork. |
| 6 | ...................... | 4 | 2 | 34 | W. of N. W.. | 18 | " " " |
| 7 | ...................... | 4 | 2 | 34 | N. W......... | ............ | In a well on the upland. |
| 8 | Wilden's ............. | 4 | 2 | 27 | S. W. of center | 18 | On East Fork. |
| 9 | ...................... | 4 | 2 | 26 | Middle S. line | ............ | Branch of East Fork. |
| 10 | Strickler's mill........ | 4 | 2 | 25 | N W......... | 16 | On East Fork. |
| 11 | Martin's.............. | 3 | 2 | 1 | S. E......... .. | 15 (?) | Near Alma. |
| 12 | B. Howel's.... ....... | 4 | 3 | 31 | N. of S. W.... | 14 to 18 | Branch of East Fork. |
| 13 | — Howel's..... ...... | 4 | 3 | 29 | S. of S. W.... | 15 to 17 | " " " |
| 14 | Pru·t's............ ...... | 4 | 3 | 29 | N E. of S. E. | 10 | " " " |
| 15 | Central City........... | 1 | 1 | 6 | N. E......... | 12 | On Crooked creek. |
| 16 | " " ........... | 1 | 1 | 6 | Middle E. half | 10 | In a shaft, fifty feet deep. |
| 17 | Centralia.............. | 1 | 1 | 18 | N. E. of S. W. | 8 (?) | In a boring, ninety feet deep (?) |
| 18 | Snyder's quarry.. ..... | 1 | 1 | 9 | N. E. of S. E. | 6 | On branch of Raccoon creek. |
| 19 | Cameron's............ | 1 | 1 | 36 | N. E. corner.. | 8 or 9 | North of Walnut Hill prairie. |
| 20 | A. Cobbel's .......... | 1 | 2 | 31 | N. of N. E... | 8 or 10 | " " " " |
| 21 | ...................... | 1 | 2 | 28 | W. side ...... | ............ | In a well, south of Raccoon creek. |
| 22 | On Raccoon creek..... | 1 | 2 | 27 | N. W......... | ............ | At the bend of the creek. |
| 23 | Mercer's .......... .... | 1 | 2 | 22 | N. E......... | 20 to 24 | On Raccoon creek. |
| 24 | ...................... | 1 | 2 | .... | S. half........ | ............ | Branch of Raccoon creek. |
| 25 | ...................... | 1 | 2 | 20 | Middle E. line | 24 (?) | In a well at S. edge of Tennessee prairie. |
| 26 | Richardson's.......... | 1 | 2 | 9 | N. W. corner. | 18 to 22 • | Edge of Tenn. prairie. |
| 27 | Hoff's................ . | 2 | 2 | 34 | N. E. of S. W. | 12 to 14 & 20 | On drain south of Crooked creek. |
| 28 | ...................... | 2 | 2 | 34 | N. W. corner. | ............ | " " " " " |
| 29 | ...................... | 2 | 2 | 33 | S. E. of N. W. | ............ | " " " " " |
| 30 | Sanders'.............. | 2 | 2 | 33 | N. E......... | 12 to 14 | " " " " " |
| 31 | ...................... | 1 | 3 | 33 | S. E. of N. W. | 9 (?) | South of Romine prairie. |
| 32 | W. Hill's.............. | 1 | 3 | 2 | S. of N. W... | Thin. | Head of Fulton creek. |
| 33 | ...................... | 2 | 3 | 34 | N............ | 6 (?) | Branch of Fulton creek. |
| 34 | Warner's.............. | 3 | 3 | 27 | Mid'le W. line | Thin (?) | In a well in the prairie. |
| 35 | Wilson's.............. | 3 | 3 | 10 | Mid'le W. side | 8 to 10 | Head of Dom's creek. |
| 36 | Bee branch........... | 3 | 3 | 13 | S. E. corner.. | ? | |
| 37 | Hensley's............. | 3 | 4 | 9 | N. W......... | 8 to 10 | North-east of Omega. |
| 38 | Mrs. Gregg's......... | 4 | 4 | 32 | N. W......... | 8 to 10 | On Lost Fork. |
| 39 | Near Lutterel's........ | 4 | 4 | 36 | S. E.......... | ? | On Skillet Fork. |
| 40 | ...................... | 4 | 4 | 26 | N. E.......... | Few inches. | North of Critchfield prairie. |
| 41 | ...................... | 4 | 4 | 14 | N............. | 2 to 6 | Branch of Skillet Fork. |

These are the points at which coal has been found near the surface, and as all this coal appears to come from one and the same stratum, with perhaps the exception of the outcrops in the vicinity of Central City, of which I have spoken above, and of those at the head of Fulton creek, we may, of course, calculate to find the same seam at the intermediate points by digging for it, except where the lower strata reach the surface, as near the Skillet Fork. It is of great importance to know whether heavier coal-beds might be discovered in this county by digging to a greater depth, and this point can only be settled in a satisfactory manner by actual experiment.* The area of the county is five hundred and seventy-six square miles. Each foot of thickness of a coal-seam extending underneath the whole, would then be capable of affording an actual yield of two thousand eight hundred million tons of coal, or a six feet bed, a yield of seventeen thousand two hundred and eighty million tons of coal in the whole county. These figures prove the vast importance of positively ascertaining the existence of this coal-bed. It is doubtful whether there is another coal-seam of paying thickness at a still greater depth, although it is not impossible.

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* A carefully conducted boring, carried down to the depth of five hundred feet, would probably settle the question as to the development of the Belleville or DuQuoin coals in this county, and if they are found here at all, their exploration and development will prove of great value to the people of this county, and it is a question of such vital importance that its final determination can not be very long delayed. The many outcrops of the small coal over the whole extent of the county, noticed in the foregoing pages, would seem to indicate conclusively that this county occupies a position so near the center of the Illinois coal-field, that the strata are very nearly horizontal in position, and consequently, if these heavy coals exist here at all, they would be found at a nearly uniform depth over the whole county. A. H. W.

*Iron-ores.*—Iron, in the shape of kidney-ore, is disseminated in concretions, in larger or smaller quantity, through many of the shales of the Coal Measures. We have found it at numerous points in this county, as may be seen in the foregoing pages, but it is still doubtful whether it is concentrated at any one point in sufficient quantity to be profitably mined for the manufacture of iron.

*Salt.*—I could ascertain but little in relation to the quality of the brine said to have been struck in the boring at Central City, at a depth of near three hundred feet; but it was said to be rather weak, and no attempt has been made to manufacture salt at that point. This brine seems to have a deep-seated source, and a strong and good supply of it might possibly be obtained by boring deeper. In the boring at Centralia, two miles distant, no brine was discovered at even a far greater depth, nor have any traces of salt been found anywhere else in the county.

*Building Materials.*—Sandstones for ordinary building purposes, especially for foundations and common walls, may be obtained at numerous points in the county, and no place is more than a few miles distant from a quarry. Many of these rocks are of rather indifferent quality, but if proper search is made, single ledges of very good stone may be discovered at many points. Lime has been burned at several localities from the limestones in the vicinity of the coal-seam, but these rocks are generally rather impure, and if a superior article of lime is wanted, it must be imported, for which the several lines of railroads offer facilities. The most prominent localities of limestone are near Raccoon creek, in the south-west part of township 1, range 2; on Bee branch, in the south-west part of township 3, range 4; near Lost Fork, in section 9, township 3, range 4, and on a branch of Skillet Fork, in section 36, township 4, range 4; but the limestones have been discovered at many other points near the upper coal-seam.

Sand for plastering and mortar can be easily obtained on many of the creeks, because they run through sandstones and other arenaceous strata.

*Timber and Agriculture.*—In describing the surface configuration of the county, I have already stated the principal facts which come under this head. Nearly half of the county is timbered land, the other somewhat larger half, prairie. The timber land presents the same leading characters which have been discussed in the report of Perry county, comprising the post-oak flats, barrens, and so on. On the flats, the post-oak still prevails, with often hardly any undergrowth on the white soil. In the barrens we find, together with a growth of white-oak, black-oak, barren hickory (*Carya tomentosa*), and other trees.

In the creek bottoms, especially in the wide bottoms of the Skillet Fork, and of the lower course of some of its tributaries, there is a heavy growth of choice timber, which is being cut in large quantities for staves, railroad ties and lumber. It consists principally of the white-oak proper (*Quercus alba*), which shows that these bottoms are at many points not wet land, although they may be occasionally overflowed; then the bottom white-oak (*Q. bicolor*), sugar tree (*Acer saicharinum*), and on lower ground, various hickories, elm, maple, water-oak (*Q. pallustris*), and others.

These bottom lands, where they are not too low, have a deep, rich soil. The post-oak flats and barrens have been described too often to require further remarks. The prairies of this county have, in part, at least, the same sub-soil which has been observed at many points in Clinton county, and described in the report of that county as a white, finely-comminuted arenaceous loam, with ferruginous nodules and concretions, which sometimes form a hard-pan of considerable thickness. I have discussed its qualities and its influence upon the surface, soil and growing crops sufficiently already, and need not advert to it again at greater length. It is certainly not a desirable sub-soil, but wherever the upper soil is deep, as is the case at many points in the prairies, this subsoil exercises less influence, because the upper soil of the prairies is almost always rich in vegetable mould, and of great fertility. At some points this subsoil contains whitish calcareous nodules in considerable quantity, for example, in the vicinity of Patoca, and it seems as if they had a favorable influence upon the quality of the land—at least they would neutralize any tendency to acidity, resulting from the great compactness of the soil, and keep it looser.

If the farming lands in this county can not be counted amongst the best in the State, still the facilities for marketing the produce are such, or might easily be made such, that the farmer can compete with richer districts. The Ohio and Mississippi Railroad brings the St. Louis market within easy reach, and affords, besides, a ready outlet to the east; while the two branches of the Illinois Central Railroad give an easy communication with all parts of the State, and especially with the Chicago market. Many fruit-growers have already availed themselves of this advantage, and have planted fine orchards on the high, rolling prairies along this road.

# CHAPTER XII.

## JEFFERSON COUNTY.

BY HENRY ENGELMANN.

Jefferson county is situated south-east of the intersection of the Illinois Central and Ohio and Mississippi railroads, and is formed by townships 1, 2, 3 and 4, south of the base line, in ranges 1, 2, 3 and 4, east of the third principal meridian, thus embracing sixteen townships, or five hundred and seventy-six square miles. More than four-fifths of this area, or about four hundred and sixty-six square miles, is timbered land, while only about one-fifth, or one hundred and ten square miles is prairie. This proportion of prairie is much smaller than in the counties farther north, and grows still less in the more southern counties.

These prairies present the same character as those in the adjoining counties of Perry and Washington, which have already been described at some length in the reports on those counties. They invariably occupy the more or less elevated lands between, and usually at some distance from, the creeks and water-courses, and have generally a considerable depth of Quaternary deposits, sometimes underlaid with shales. It is seldom that rocks are found in the prairies, even by digging to some depth, though at some places timbered hills occur in the prairie, which are underlaid with solid rocky strata, and rise above the level of the prairie, either within its bounds or at its edge. Knob prairie has its name from such a hill or knob.

The timbered portion of the county is partly flat, but most of it is undulating or broken, in consequence of the numerous water-courses which traverse the county in every direction. It has some post-oak flats, also some wet flats at the edge of prairies, in which water-oak predominates; but more oak-barrens, with a growth of black-oak, white-oak, post-oak, hickory, etc. The timber in the creek-bottoms is generally quite heavy, and consists of swamp white-oak, water-oak, sugar-maple, sycamore, black-walnut, white-walnut, etc. In the extreme south-east part of the county, however, I observed an occasional tree of more southern affinity, such as the sweet-gum.

The county is plentifully supplied with running water, principally by the branches of Big Muddy river, which head near the north line of the county, and traverse it in a southerly direction, with many smaller creeks which empty into them, both from the west and east. The main branch of Big Muddy river heads near the north-west corner of the county, some miles south-east of Centralia; while some other ravines near by run westward toward Crooked creek and the Kaskaskia river. The Little Muddy river passes through the south-west corner of the county. In the north-east part of the county is Horse creek, a tributary of the Little Wabash river, and all the branches on the east line of the county take their course eastward, toward the Little Wabash.

The geological formations of this county, like those of all the adjoining counties, are members of the coal formation. All over the county, with the exception of a limited area in the south-west corner, we find the same strata which we have traced all over the adjoining county of Marion—a sub-division of the Upper Coal Measures, including a coal-seam which varies from six to twenty-four inches in thickness. At a greater depth we may expect to find the DuQuoin coal-bed; and the sandstones overlying this coal, and its associated limestones, have been traced over a considerable area east of the outcrop of the coal, and attain a considerable but variable thickness, sometimes amounting to more than two hundred feet, and appear to pass across the extreme south-west corner of Jefferson county. The sandstones on the Little Muddy, east of Tamaroa, are probably members of this formation.

The Shoal-creek limestone has no great thickness. It varies generally between seven and fifteen feet; but being the only prominent limestone between two heavy bodies of sandstone, it forms a well-marked horizon, and can be readily traced over a long distance. It passes across Clinton and Washington counties, toward the south-west corner of Jefferson. I have observed it near Highland, Jamestown, Breese, Carlyle, Nashville; farther south-east, on the waters of Beaucoup creek, and near Little Muddy river, not far from the railroad bridge north of Coloma. Still farther south-east, in Perry county, only a quarter of a mile from the Jefferson county line, on Little Muddy river, just before it enters the latter county, we find an outcrop of evidently the same limestone. Here five feet of it are exposed, covered with soil. The whole of it may possibly be thicker. It rests on one foot of shales, and three feet of black laminated slates, which reach to the water-level. Coal, probably fifteen inches thick, has been dug from the bed of the creek.

From this point the Shoal-creek limestone must pass into Jefferson county, crossing the lower course of Bald creek and other affluents of the Little Muddy; but the country is mostly covered with heavy Quaternary deposits, and is thinly settled, so that artificial exposures are wanting; consequently exposures of any rocks are scarce, and the limestone has not been discovered. Higher up these creeks, and in the barrens, sandstones crop out at a few points, evidently the higher ones, especially in the south-west quarter of section 9, in the east part of section 17, in the north-east quarter of section 29, the north part of section 28, and the south part of section 21, all in township 4, range 1. It was only in a well in the south-west quarter of section 29, that, at a depth of thirty feet, the black laminated slate was struck. This is exactly where we should expect to find it, in the direct trend of the Shoal-creek limestone formation.

All the rest of the county is occupied by the higher sandstone formation, the same which covers the whole of Marion county. This formation consists principally of alternating layers of sandstone and arenaceous and argillaceous shales. At some points the sandstones are more purely quartzose, harder, and therefore more prominently exposed; at others they are subordinate, and the shales predominate largely. Almost every where single layers of the sandstone can be found of sufficient hardness and smoothness for building purposes. This formation, being part of the Coal Measure system, may be expected to contain some stone-coal, but it is not rich in this mineral. The only coal-bed of any importance occurs at a considerable distance above its base, but extends, with remarkable uniformity, over a large area. I have discovered it at numerous points throughout Jefferson and Marion counties, and it undoubtedly extends much farther. It varies from six to twenty-four and even thirty inches in thickness, and may be said to average from twelve to eighteen inches of good coal. It is of considerable local importance, being used extensively in this district, and has been opened at numerous points. At some places this coal is quite pure and free from sulphur; at others it contains much slate and sulphuret of iron. Where the bed is thicker it generally contains slate partings. At a few points the slate and carbonaceous matter are so completely mixed that the whole assumes a slaty appearance, and a semblance of cannel-coal, with concoidal fracture. The coal is then, however, overcharged with earthy matter. The vertical and horizontal partings of the bed are generally well defined, and cross at nearly right angles, so that the coal breaks in cubes. It has a resinous lustre.

Closely connected with this coal, above it, and separated from it by some clay shale, we frequently find a calcareous stratum. At some points this is a tolerably pure limestone, of five feet in thickness; but generally it is less, and passes locally into a black calcareous slate, with numerous fossils, or is entirely wanting. Where the limestone is best developed the coal would seem to diminish. The coal rests on clay shales, underneath which, occasionally, more calcareous matter has been observed, mixed with the sandstone, forming a hard calcareous sand-rock, or, in the language of the people, a bastard sandstone, or bastard limestone.

The strata over the whole county do not present a regular dip in one direction, but lie in waves, and rise and fall more or less in conformity with the surface-configuration of the country. We find them, therefore, again and again, at points where they would have disappeared if the dip presented at other points had not been reversed. I have noticed the same thing in Marion county.

A straight line from Ashley to the Jefferson and Franklin county line, south of Spring Garden, approximately marks the south-western limit of this coal. Some traces of coal have been discovered farther south-west, especially on Hurricane creek, in the north-east quarter of section 24, township 4, range 1; but I am not positive whether this is the same bed, or a lower seam in the sandstone formation. North-east of this line the coal has been observed at numerous points, except in the low and flat district on both sides of the Big Muddy and Casey's Fork, south of Mount Vernon, where no rocks have been discovered.

In the north-west corner of the county sandstone is sparingly exposed in the ravines north of the prairie, in section 6, township 1, range 1. It has been struck in digging wells at several points farther south in this prairie, along the county line. The coal has been found in wells near Irvington, about a foot thick. Some miles to the eastward, on the east side of this part of Grand prairie, on Big Muddy river and its branches, the coal and rocks are largely exposed, of which more will be said below. Near the county line, on the upper course of Ray's creek, only occasional outcrops of shales and sandstones were observed—one at the bridge on the Richview and Jefferson City road. Half a mile below that bridge, in the north part of section 8, township 2, range 1, I found in the bank of the creek some heavy ledges of sandstone, and below them slabs of the impure limestone, over a foot in thickness, partly slaty, partly compact and silicious. The coal might easily be discovered here, if search were made by digging. The same strata crops out on Cooley branch, in the south-west quarter of section 9, and tumbling pieces of the limestone are found at various points nearer Richview. Sandstones form the banks of Ray's creek at many points farther down, especially in sections 21 and 28 of this township; but still farther down the creek there are no more rocks exposed for several miles; although they may be found by digging to a small depth nearly all over the barreny hills.

At the eastern edge of the prairie, some miles south-east of Ashley, the sandstones and shales, and also the limestone and coal, were observed at various points. Close to the Mount Vernon and Ashley road, at the meeting-house in the north-east quarter of section 6, township 3, range 1, sandstone crops out at the head of the ravine. A little lower down are seen blocks of the limestone; then, pieces of black slate, and in the bank, in place, shales with calcareous seams. This is evidently the horizon of the coal-bed. One mile farther south, in the north-east quarter of section 7, at Mr. HUNTER'S, the coal has actually been exposed and dug to some extent, in a ravine at the edge of the prairie, whence it is taken to Ashley and used by blacksmiths in the vicinity. The bed varies in thickness from ten to sixteen inches, is capped by bluish-gray slaty shales, some three feet thick, above which I noticed from four to sixteen inches of limestone. A little lower down the ravine the coal is again exposed with the underlying sandstones; and farther on, in the west part of section 9, the coal is eight or ten inches thick, and the limestone three feet, with two and a half feet of shales intervening between the two. The same strata are found in other branches farther south; but the limestone is quite irregular in its development. At Mr. GREEN'S, also at the edge of the prairie, in the north-east quarter of section 17, the coal is exposed from twelve to sixteen inches thick, with a shale parting, capped by from two to three feet of shale, and then two feet of limestone. Close by, at Mr. PIERCE'S, the lower part of the coal, a few inches thick, is hard and slaty, of the appearance of an impure cannel-coal, but is rather a carbonaceous slate, while the upper part of the seam is rotten. On higher ground, near these points, some sandstone has been noticed, apparently the one above the limestone. Following down the ravine, from Mr. PIERCE'S, we soon find shales, with kidney-ore, and then traces of the limestone and coal, which strata also crop out farther down the creek, in section 16.

Round the south end of Grand prairie, sandstones have been discovered in place at a few points, apparently those below the coal, which latter does not appear to reach very far to the south-west. A sandstone-quarry has been worked in section 30, and occasional outcrops are found in section 32, in the south-east quarter of section 33, and more in sections 27 and 26, and in the north part of section 34, between this prairie and Knob prairie.

In the north part of Knob prairie, these sandstones are exposed on a ravine near the Pinckneyville and Mt. Vernon road, near the middle of the north line of section 25, township 3, range 1. It there breaks in thin, hard slabs, in consequence of a false stratification. Hardly a mile farther north-east, the coal and accompanying rocks were again observed on a ravine south of the road, near the middle of section 19, township 3, range 2, and also near the bridge over Ray's creek, in the north part of section 19. On the ravine, the black slate was exposed, with a highly calcareous fossiliferous layer at its base, and at another point, traces of the coal. At the bridge, the bed of the creek is formed of a hard sandstone, or mudstone, with calcareous portions, while the banks consist of shales, with concretions of iron-ore. A little below the bridge, the bed-rock changes to an impure siliceous limestone. These strata may underlie the coal, fragments of which are strewn in the creek. A short distance above the bridge, a high bank on the creek shows on top shaly strata, then two feet of the dark blue laminated slate, then from four to ten inches of the calcareous fossiliferous slate, below that, underneath a parting of shale, two inches of coal and several feet of clay shale. Although the coal is so meagerly developed here, it is undoubtedly the same bed. Three-quarters of a mile higher up the creek, in the north-east quarter of section 24, the bank consists of arenaceous shaly strata, with thin layers of harder sandstone and concretions of iron-ore; and some miles farther up, in the south-west quarter of section 1, I noticed, in a high bank, traces of sandstone, of the calcareous slate, and of the impure limestone. These strata were not sufficiently exposed to see the coal, although it must be present. No outcrops occur lower down on Ray's creek, nor on Big Muddy river, from this vicinity south to the county line.

In the south part of Knob prairie, the Knob, situated in the south-east corner of section 36, township 3, range 1, is formed of sandstones and arenaceous shales. South of this prairie, between it and Horse prairie, sandstones and shales are found all over the barrens. They are exposed principally near Buck creek, in the south and east part of section 12, and near Hurricane creek, in the south part of section 13, in the north part of section 24, and east from there, across the range line. At the latter creek, in the north-east corner of section 24, coal is again exposed. At the foot of a sandstone hill, we find shales, with concretions of iron-ore, below them, dark blue laminated slates, with calcareous portions, and, if I was correctly informed, seven inches of coal. The coal was not exposed at the time of my visit. This is possibly an outcrop of the coal-seam so often mentioned before, although it is six miles from the last described and nearest point on Ray's creek, where this coal has been discovered.

On the outskirts of Horse prairie, sandstones, and occasionally shales, are found in wells at various points, especially in sections 30, township 4, range 2, and 35, township 4, range 1, also in the prairie near the range line. Although water is generally obtained there in the Quarternary or drift deposits, sandstones are found south-east of the town of Winfield, in the north-west quarter of section 32, township 4, range 2, where a quarry has been opened. From Horse prairie, west and north-west, to Little Muddy, sandstones underlie an extensive area, and crop out in the barrens and on the branches at numerous points. They are apparently those between the above-named coal-seam and the Shoal-creek limestone. Of the latter, and of its probable course across the south-west corner of the county, I have spoken above.

Turning north again, we find the coal variously exposed on the upper course of Big Muddy river, near the eastern arm of Grand prairie, east of Irvington and Richview. The sandstone forms prominent layers on every ravine at the edge of the prairie in sections 26, 22, 15 and 16, township 1, range 1. At Mr. RICHARD BREESE's place, in the north-east quarter of section 22, on a ravine below the outcrops of sandstone, the coal has been exposed, and has been wrought to some extent. It is capped by some gray slate, and blocks of hard, impure limestone were also noticed. They were not seen *in situ*, but evidently come from above the coal. The latter is here eight inches thick, of very fair quality, and of the usual appearance of this coal, breaking in square blocks. It has also been found farther west in the prairie, in a well at Mr. JACOB BREESE'S, in section 21, and farther north, in the adjoining section 15, in the bank of Big

Muddy river, at Mr. HARTLEY'S. Here we have, first, some fire-clay, then two inches of coal, one foot of slaty shales, then from five to eight inches of good coal, two feet of blue, slaty shale, and above them, gray shales, with some kidney iron-ore. A few yards farther on, sandstones rise to the surface from below the level of the creek, and consist, in part, of the hard, strongly-cemented calcareous kind.

In the adjoining section (14) the coal has been discovered at several points, especially in the bank of a branch of Big Muddy, at Mr. THOMAS MOORE'S, in the north-west quarter of section 14. The bed of the creek is there formed of the hard sand-rock, and above it follows some clay shale; then the coal, which is from six to eleven inches thick, and of very fair quality; then more shale. Half a mile farther east, in the north-east quarter of section 14, is another outcrop of the coal, on a main branch of the creek. It is similar to the last one; but above the shale, which overlies the coal, we have there an irregular layer of the impure limestone, varying in thickness from one inch to two feet. This limestone has been noticed at various points in this vicinity. The coal has also been discovered in the north-east quarter of section 11, near the south line of section 13, and near the south-east corner of section 33. From Mr. MOORE'S southward, sandstones are exposed extensively along the banks of the creek for a considerable distance, through section 23, the north part of section 26, and section 25.

At the "Copperas bluff," on the east bank of the creek, near the south line of the south-east quarter of section 25, township 1, range 1, we find an exposure of over twenty feet of shaly strata, with much kidney-iron ore. Upon close examination, we discover, in a little ravine amongst the shales, about twelve inches of coal, of which, however, only six inches appear to be of good quality, the rest slaty; and above the coal the limestone, which is here bluish-gray, slaty, highly fossiliferous, and over fifteen inches thick. It is principally seen tumbling in large blocks out of its original position.

Three-quarters of a mile farther east, on McGinnis' branch, the coal and limestone have also been found, especially in the south part of section 30, and the north part of section 31, township 1, range 2. At the latter place the coal-bed is sixteen inches thick, but has a parting of slate, so that the good coal is not more than ten or twelve inches thick. Underneath it follow twenty inches of shale; then four inches of an impure coal, or rather carbonaceous and argillaceous shales. Above the coal there are also several feet of argillaceous shale. At the other place we find six inches of fine coal at the water-level, and more may be found farther under some of the intervening shales. Above it there are some inches of calcareous shale, and then a heavy stratum of the grayish-blue slaty limestone.

At and above the mouth of McGinnis' branch the sandstones capping these strata crop out in the bank of Muddy river, together with the shales and iron ore. They rise north-westward up the stream, so that a little farther on the limestone reaches the surface, and is here two feet or more thick, and hard and silicious. The coal-bed might be readily found. It has been wrought a short distance south from there, at several points near the village of Jefferson City, situated near the center of section 1, township 2, range 1. On a small branch north-east of the town, in the north-east quarter of section 1, the coal is sixteen inches thick; but only one-half of it is fair, the remainder being slaty. I noticed there, also, some of the limestone. South-east of the town the upper sandstones are prominently developed at the head of the ravines, and underneath them is found a considerable thickness of shales, and then the coal; but I did not see any traces of the limestone. Nearly two miles farther south, in the north-east quarter of section 13, township 2, range 1, and in the north-west quarter of section 18, township 2, range 2, I observed, on some branches, traces of the limestone, together with sandstone, shales and iron ores, and also signs of the coal, but no good exposures. The sandstone and shales continue in the banks of the creek to Muddy river, and are exposed on that stream above the mouth of the creek, in the north-west quarter of section 17, and again one and a half miles farther down, in the north-east quarter of section 30 (?). This is the last outcrop of rocks on the stream in Jefferson county. Thence southward it has only mud banks.

Near the north-east corner of West Long prairie some sandstone, shales and iron ore were seen in the low banks of a ravine, in the north-west quarter of section 30, township 2, range 2, and similar rocks are occasionally struck in wells in this vicinity; but outcrops of rocks are hardly to be found elsewhere for several miles east and west of Long prairie.

In my report on Marion county I have enumerated various points where this coal-bed has been discovered near the northern rim of Walnut Hill prairie. Near the western and eastern edges of this prairie no exposures of any kind are known in Jefferson county. Only near the south end of it, on the road from Centralia to Mount Vernon, the coal and its accompanying strata have again been noticed on a branch of Little creek, on Mr. WILLIAM SNOW'S place, in the south-east quarter of section 17, and for half a mile up the branch, on Mr. JOHN FOSTER'S land, in the south-west quarter of section 16, township 1, range 2. The coal presents the same appearance as elsewhere, and is at one point at least fourteen inches thick. With it I observed shaly strata, and the overlying impure limestone, which reaches a thickness of two feet or more. In the prairie, near the center of section 17, Mr. SNOW dug a well forty feet deep, through clay and sand, and no rocks are exposed any where else on the creeks of this vicinity, except a mile or more farther down the creek, where we find tumbling masses of the limestone and sandstone not far from the road.

Below the south-west end of Jordan prairie sandstone is exposed on a branch near the middle of section 34, township 1, range 2, and more on a ravine at the road near the west line of section 35, where harder layers alternate with more shaly ones. Farther up that ravine, near the edge of the prairie, the coal was again discovered, and the following section of the strata observed: 1st. Shale, forming the bank of the drain. 2d. Coal, from twelve to fifteen inches thick. 3d. A parting of shale, four inches. 4th. Coal, from nine to ten inches thick. 5th. Shales, several feet exposed. Thus we have here from twenty-one to twenty-five inches of coal, of fair quality, while the limestone is either higher above the coal or entirely wanting.

About a mile north-east from this point, near the eastern rim of Jordan prairie, the limestone is so prominently developed that the place is known as "Limestone Branch," while the coal has not been discovered there. It may yet be found, if holes are dug at the proper elevation. This is in the south-west quarter of section 25, township 1, range 2. At the head of the branch some sandstone and shaly, arenaceous strata are exposed, and underneath them the limestone, which is gray, has a fine earthy grain, and a few fossils; decomposition gives it a brownish color. It contains much earthy matter, and is apparently five feet thick, and underlaid with shales. It crops out at numerous points over an area of not more than half a mile in width. One mile south of the limestone point, in the south-west quarter of section 36, at Mr. JOHN MCMANN'S, at the edge of the prairie, the coal has been found under four feet of soil, and is reported to have been sixteen inches thick, and of good quality. East of these points, on the Salem and Mount Vernon road, and from there to the east on Casey's Fork of Muddy river, sandstone is prominently developed in the south part of section 35, and in the east part of section 36, township 1, range 2, and south-east from there across the range line; and, in fact, for miles up and down the valley of Casey's Fork, although, on the banks of that stream, exposures are by no means frequent in this vicinity.

North of the "Limestone Branch" the slaty, fossiliferous limestone, which is a certain indication of the coal, has been noticed, together with shales, near the meeting-house on the Salem road, just south of where the road enters Jordan prairie, in the north-west quarter of section 28, township 1, range 2.

In that prairie, at Rome, near the center of section 13, the coal is struck in every well, only ten feet below the surface, and is said to be ten inches thick. At the edge of the prairie south-east of Rome, the coal has been mined to some extent, especially at Curtis' digging, in the south-west quarter of section 18, township 1, range 3. At that point the bed is fourteen inches thick, of which ten is good coal. I noticed in connection with it some sulphuret of iron; below it, shales, and above it, shales and fossiliferous calcareous slate; and I found sandstone in the vicinity, in the north-west quarter of section 18, and at other points. The coal has likewise been found near the middle of the north line of the north-east quarter of section 24, and farther east, in the south-west quarter of section 17, on JOHN BURNETT'S land, and in the north-west quarter of section 17, on BENJAMIN HAWKINS' land, a short distance from Casey's fork. At all these points the coal was from ten to twelve inches thick, and accompanied by shales, the calcareous slate, and sandstone. North of these points, only sandstone has been observed, which is far more prominently exposed than farther south, and appears to be less mixed with shales.

Nearer Mount Vernon, the sandstones and shales may be observed at numerous points, and the coal has been noticed in several places, although few of the outcrops are prominent. Near the south-west corner of section 7, township 2, range 3, at Dr. MAXY'S, the coal has been dug some years ago from the bed of a branch. There were twelve inches of good coal, capped by shales. Three-quarters of a mile south from there, in the south-east quarter of section 13, the coal has also been found; and much has been dug still farther south, on another ravine of Miner's branch, at the Union camp-ground, in the south-east quarter of section 24, township 2, range 2. At this latter place it is twelve inches thick, of fair quality, contains little sulphuret, and is covered only with soil. Below it, I observed a few inches of shales and sandstone, in thin layers, which latter furnishes good building material. A mile east from this last point, on the lower course of the same branch, in the north-east quarter of section 19, the coal-seam measures sixteen inches, of which, two consist of a shaly parting. Above it, there are some inches of a shaly material; then eighteen inches of the fossiliferous calcareous slate, followed by shales, with kidney iron-ore. Shales also appear below the coal, while sandstone crops out near by.

Again, one mile farther south-east, at Toll's old mill, a short distance north of Mount Vernon, in the south-west quarter of section 20, township 2, range 3, the bank of the East Fork is formed by some fifteen feet of slaty shales, with much carbonate of iron in sheets or concretions. This is the shale above the coal, which latter lies in the bed of the stream, is twelve or fourteen inches thick, and of inferior quality. Of the calcareous slate, I only noticed loose masses, which appeared to have become detached from the bank. The shales crop out at several other points just above the old mill.

Mount Vernon, the county seat, is situated on the hills west of the East Fork, principally in the south-west quarter of section 29, township 2, range 3, extending into the south-east quarter of section 30. In digging to a depth of twelve or fifteen feet, shales are struck which are generally arenaceous. At a depth of about eighteen feet the coal is found, near twelve inches thick. Water is obtained at depths varying from twelve to twenty feet. It can only be used for household purposes in the wet season. After that time it becomes too highly charged with salts, principally of iron. Cistern water is therefore generally used in town. At the south-eastern edge of the town are some remarkable springs of this mineral water, owned by Dr. WM. DUFF GREEN, of which more will be said below. In the vicinity of the town, shales and tumbling masses of sandstone and limestone are found at several points, indicating the presence of the coal-seam.

West and south-west of Mount Vernon, towards Muddy river, there are hardly any exposures of rocks. Sandstones and shales have been found at a few isolated points. East of town, on the East Fork, the only outcrop is near the fair grounds, near the north-west corner of section 33; and at the ford at that point, the bed of the river consists of slaty sandstone, and the bank, of argillaceous slaty shale. Besides, I observed so much of the impure limestone in tumbling masses, that I became satisfied that it must be in place a few feet higher, hidden by soil and detritus. A mile farther down, there is another rocky shoal, and just above the bridge, on the Lynchburg road, in the north part of section 9, township 3, range 3, shaly sandstone forms the bed and bank of the stream. This is the last rocky outcrop on the East Fork in this county.

South of Mount Vernon, between the main and east forks of Muddy river, exposures of the strata are few and far between. A mile and a half south-east of the town, on Mr. JONE'S place, in the north-west quarter of section 6, the coal has been dug some years ago, from the bottom of a ravine in Town prairie. It appears to have been twelve or fifteen inches thick, and covered directly by the soil. It has also been struck in wells in this vicinity. Two miles due south of town, on the same ravine, close to the edge of the prairie, in the north-east corner of section 7, sandstone crops out and is quarried to some extent for building purposes. It is soft, but hardens in the wall, and the layers are of convenient thickness for ordinary use. Farther south, between Town prairie and Elk prairie, sandstones and arenaceous shales are exposed at numerous points in the barrens, especially in sections 25 and 26, and in the north-west corner of section 36, township 3, range 2. They evidently underlie this timbered district at a small depth. Farther south, outcrops are not known.

The north-eastern part of the county, east of the East Fork, is also occupied by the same formation, and the sandstones, especially, are exposed at numerous points; but the coal has also been discovered at various localities. Thus we find it on one of the eastern affluents of the East Fork, in and near the north-west corner of section 4, township 2, range 3, near Mr. EDWIN COLLINS'. The coal has been dug from the bed of the branch; was from twelve to fourteen inches thick, and of very fair quality. The bank above it showed slaty shales, with kidney iron-ore, and I noticed, besides, slabs of the calcareous fossiliferous slate and tumbling sandstones. We find coal, again, one and one-quarter miles farther north, on another branch, in the south-west quarter of section 28, township 1, range 3; and near the head of a third, in the south-west quarter of section 9, township 2, range 5, at Mr. WM. H. CHASTINER'S. Here four or five inches of it are exposed between sandstones, of which some are hard and calcareous. No slate or limestone were found with it. I believe this last to be the same bed of coal, although it may possibly be distinct. It is said to make its appearance again half a mile farther west, on another branch of the same creek.

On the various branches of Seven-mile creek, sandstones have been observed. The first known outcrops of coal occur just north of the road leading east from Mt. Vernon, in the south-west quarter of section 23, township 2, range 3, and in the east part of section 22, near Mr. ROBERT GRANT'S place. The slaty shales form the bank of the ravine, with sandy strata above them. The coal which forms the bed of the ravine was covered up at the time of my visit. On another branch of the creek, two and a half miles farther south-east, at Mr. JAMES COLLINS', in the south-east quarter of section 36, township 2, range 3, the coal has been dug to some extent. It was there nine inches thick, and covered with six feet of shales. Near by, on a branch in the north-east quarter of section 1, township 3, range 3, it was found seven inches thick, accompanied with sandstone, shales, iron-ore, and a thin layer of the slaty limestone. One mile from this point is Lynch's coal-bank, in the north-east quarter of section 2, township 3, range 3, where Mr. COLLINS has dug far more coal than at his own place. It is the same vein, although here from fourteen to sixteen inches thick, and of good quality. On the main Seven-mile creek, the coal is exposed one mile from its mouth, near the center (?) of section 3, township 3, range 3. It is in the lower part of the bank of the creek, and at the time of my visit was covered with water. It appears to be from twelve to sixteen inches thick, of the same general appearance of all this coal, but of rather indifferent quality. The higher portion of the bank consists of shales, and the summit of heavy layers of a fine sandstone.

On Horse creek, in the extreme north-east part of the county, on the waters of Wabash river, the sandstones form the principal exposures. In the south-west quarter of section 7, township 1, range 4, the bank of the creek is formed principally of shaly sandstones. At one point it rises to a height of thirty feet, and consists mainly of slaty shales, with some intercalated sandstone, and twenty-five feet above its base, a seam of coal, capped with black slate. The strata had slipped too much out of place to obtain an accurate measurement. One mile farther south, in the south-east quarter of section 18, on the upland, the same coal has been discovered in digging a well, and near the middle of the east half of section 19, township 1, range 4, on Coal-bank creek, it has been worked to some extent. I observed there, in the bank of the creek, twenty-five feet of slaty and partly arenaceous shales, which in their upper part contain much iron-ore, with sandstones following above. The coal has been dug here from the bed of the creek, but is not now exposed. It is said to be from eight to twelve inches thick, and of good quality. I noticed no black slate with it, and only traces of the slaty limestone. The coal extends from this point down the creek to its mouth. It has also been dug in the south-east quarter of section 17, at the water's edge. It is there from fifteen to eighteen inches thick, of very fair quality, firm, and contains little sulphur. Here, too, only traces of the black slate were observed, besides the shales and sandstone. These diggings on Coal-bank creek are the only places for miles around where coal has been mined. A short distance below the mouth of this creek, at a ford of Horse creek, in the south-west quarter of section 16, its bank consists again of shales, etc., with some six inches of coal. I am not certain whether this is the same vein as the one described last, or whether the latter does not lie underneath the bed of the stream, separated from the outcropping one by some intervening strata of rock. Down Horse creek we find sandstones and shales at a ford in the east part of section 21, and twenty-five feet of sandstone at Haynie's old mill, in the south-east quarter of section 27, and more still further in the hills. The prominent hills on the south side of the creek, west of the Wayne county line, in the north part of section 1, township 2, range 4, are capped by sandstone, underneath which follows a hard and dark grey slate, which changes imperceptibly to a slaty limestone, some of which is very hard. Below that, shales seem to follow, and traces of coal has been discovered. This is apparently the same horizon of our coal-seam. Some of the limestone closely resembles a similar rock found near the coal east of Lynchburg, in this county, and the same has been noticed in the extreme north-east of the county, near Squire WELLS', in and near the south-west quarter of section 2, township 1, range 4, where it is found tumbling on the hill-side, while the summit is likewise formed by sandstone.

Near Farington, and along Puncheon Camp creek, and on Four-mile creek, on the north side of East Long prairie, throughout township 2, range 4, sandstones alone have been observed, with the single exception, as far as I could learn, of one point on the county line, near the middle of the east line of section 13, north of the Mt. Vernon and Fairfield road, near Mr. JOSEPH HENRY'S, where the slaty limestone makes its appearance.

In the south-western part of the county, the sandstones are not so prominently exposed, owing, perhaps, to the less broken character of the country; but together with the shales, the coal-seam, and the slaty, calcareous stratum, they have been found at numerous points. I have stated above, that on the East, or Casey's fork of Muddy river, no rocks have been discovered in this county below the bridge on the Mt. Vernon and Lynchburg road; nor are there any in the low and flat district between the East Fork and the Spring Garden road. Some sandstone was observed on that road, half a mile from the bridge, in the south-east quarter of section 9, township 3, range 3, and the coal has been found in digging a well on a ravine near Mr. MILLS', near the south line of section 10, on the Morse prairie road, only three or four feet under ground. It is said to have been fifteen inches thick, and of good quality. A mile south-east from there, where the road crosses Dodd's creek, we find a high exposure of slaty shales, much the same as at Toll's mill, near Mt. Vernon, and apparently a continuation of the same strata, while sandstone is in the upper part of the hills, and continues all along up Dodd's creek, through sections 13, 14, etc.

Near the head of one of the branches of the creek, in the south-east quarter of section 13, township 3, range 3, is Warren's coal-bank, which, though differing much from other outcrops of our coal-seam, can not be regarded as a different one, but merely as a local variation. Gray slaty shales crop out there in the hillside, and below them, the coal. It is at least twelve, perhaps sixteen inches thick, and breaks in cubes which readily split horizontally, while the cross-fracture is conchoidal. It has the appearance of cannel-coal. Underneath it, is some fire-clay, and then, hard sand-rock; while sandstones appear to form the summit of the hill.

Sandstones and shales underlie the upland between Dodd's and Atchison creeks, and have been found in section 27; but outcrops are scarce, except on some branches of Atchison creek, near a spur of Morse prairie, in the south part of section 1, and the north-west quarter of section 12, township 4, range 3, and in section 6, township 4, range 4, where we have the same strata as on Dodd's creek. The coal has been discovered on this creek, in Morse prairie, on Mr. John W. Miller's place, in the north-west quarter of section 5, township 4, range 4, where it is said to be twelve inches thick, and covered only with three feet of soil, but has not been much opened.

The next creek south is Gun Prairie creek, which runs all along between mud banks. The principal exposures of rocks on its branches are some sandstone in the south-west quarter of section 13, township 4, range 3, and near the edge of Morse prairie, in the south-west quarter of section 20, and the north-west quarter of section 29, township 4, range 4. At the town of Spring Garden, in Gun prairie, water is obtained by digging down from ten to twenty feet deep, partly in the Quaternary, partly in shales. At the Spring Garden mill, one mile and a half south of the town, the coal is exposed in a high bank on a branch of the creek, in the south-west quarter of section 26, township 4, range 3. It is from twelve to fourteen inches thick, rests on fire-clay, and is capped by a little slate, and then eighteen or more inches of the fossiliferous, calcareous slate, covered by soil. Higher in the hill, sandstone has been found. The coal contains here some sulphuret of iron. Half a mile farther south, in the middle of the west half of section 35, the coal has again been found on a ravine.

Lynchburg is situated at the northern edge of Morse prairie, in the south-east corner of the south-west quarter of section 5, township 3, range 4. In the vicinity of the town sandstone and shales are struck in digging wells, at a small depth, and, a little deeper, the coal. A mile and a half east of the town, on Auxier creek and its branches, are several coal diggings of much local reputation. First, we come to Wilkeson's, close to the edge of the prairie, on a small branch, in the south-east quarter of section 4, township 3, range 4. We noticed there in the bank a few feet of shales, which inclose kidney-ore. From underneath these the coal was formerly dug, but is not now to be seen.

A short distance up the branch we find in its bed an outcrop of the dark bluish-gray, hard and partly slaty limestone, apparently twelve inches thick, the same which was observed at various points farther north, and which, in other localities, is represented by the calcareous slate, so rich in fossil remains. On another branch, close by, this limestone is again exposed, capped with some slaty strata and sandstone.

The next is Shelton's coal-digging, on the main creek, just north of the road, in the south-west quarter of section 3, which supplies the country for miles around with its blacksmith coal. The bed, which consists of sixteen or eighteen inches of good coal, lies just underneath the creek-level. In the bank, above the coal, are some feet of slaty shales, with iron-ore. In breaking, the coal follows the horizontal and vertical partings, and forms fine solid cubes of considerable firmness and luster, which exhibit well the alternation of more or less shining layers. It contains little sulphur, but the partings are brown, from oxyd of iron, produced by the decomposition of sulphuret of iron, which probably remains undecomposed in portions of the stratum farther removed from the outcrops. Next, we find the coal just south of the road; and a little farther, in the extreme north-west corner of section 10, at widow JORDAN'S, the coal and the shaly strata underneath it, rise above the level of the creek. The coal here is thirteen or fourteen inches thick, and at another point, from eighteen to twenty inches, and of the same quality as at the former place—except that I noticed with it some lumps of sulphuret of iron. The next point at which the coal has been discovered, is one mile farther south, on much higher ground, on a branch of the creek at the edge of the prairie, at Mr. REESE'S, in the south-east quarter of section 9. It has been dug there to some extent. Its quality is similar to SHELTON'S. Above it, I noticed traces of the limestone in the form of a calcareous slate. Below it, a considerable thickness of sandstone is exposed, which continues on the branch to the creek. One mile farther south-west, in the middle of the east half of section 17, the coal has been found on a ravine in the prairie, on Mr. J. C. JONES' field; and near the south-east corner of the section, layers of a hard, thinly-stratified and partly ripple-marked sandstone, (which has frequently been mistaken for limestone), crop out on another ravine of Rocky branch, along which sandstones, and lower down also shales, continue across the south part of section 16, and the south-west quarter of section 15, township 3, range 4, to Auxier creek. On the latter, in the north-west quarter of section 22, the bank consists of arenaceous and shaly strata, and some coal has been found above them in the bank. It is not now exposed, but loose fragments of it may be seen. I could not learn particulars in regard to it. Thence, down Auxier creek, to the county line, sandstones are occasionally found in the edge of the low bluffs on the south side. On its north side rocks are unknown for some distance.

The coal was next observed four miles farther south, on Stone-coal branch of Shelton Fork, at Mr. EDWARD PRICE'S place, on the Mount Vernon and McLeansboro road, in the north-east quarter of section 10, township 4, range 4. It is in the bed of the branch, and not opened at present, but has formerly been worked to some extent. It appears to be from sixteen to eighteen inches thick, and underlaid with sandstone, part of which is thinly stratified and shaly; the rest firmly cemented and exceedingly hard. The water in this vicinity is at some points highly impregnated with salts, especially salts of iron, originating from the decomposition of the sulphuret of iron of the coal-bank. The coal has also been found in a well at Mr. SHIPLEY'S, in the north-east corner of section 2, farther down on this branch.

The next prominent exposure of coal is two and a half miles south-east of PRICE'S, east of Wilbank, on another branch of Shelton Fork, just below the edge of the prairie, in the north-west quarter of section 24, and reaching into section 23. It is known as Bowen's coal-bank. A considerable quantity of coal has been obtained there by the blacksmiths of the vicinity. It is eighteen inches thick, and of fair quality. At some points it is directly covered with soil; at others, with blue slates. No trace of the limestone was noticed. Above and below the diggings sandstones crop out on the branch, and they form prominent bluffs along it in the north-east quarter of section 23, and in the east part of section 14, close to the edge of the high prairie, and even farther down in the south-west quarter of section 12. Half a mile south-west of Bowen's coal-bank the coal has also been discovered on a prairie ravine, on MCPHERSON'S old place, in the south-east quarter of section 23.

In the extreme south-east corner of the county, south of Morse prairie, the coal is exposed on branches of Sugar-camp creek, at Roundtree's mill, in the north-east quarter of section 35, and at Dr. WILKEY'S, near the middle of the west line of section 36, township 4, range 4. At the former place the coal crops out just above the bed of the branch, and is from nineteen to twenty inches thick, with partings of shale, otherwise of very fair quality. Above it, I measured ten inches of slates; then, one foot of sandstone and six feet of gray slaty shales. Higher in the hill are sandstones. Farther down the branch, these sandstones dip to the water-level. Across the hill, at Dr. WILKEY'S, the coal is principally dug in the creek-bottom, from underneath the alluvium, but may also be seen in the side of the bluff, underneath other strata. It is nineteen inches thick, and contains much sulphuret of iron. Above it, we see arenaceous and slaty shales, and over two and a half feet of the characteristic calcareous slate, with its numerous fossils. This rock was wanting at ROUNDTREE'S, on the other side of the hill. We see from this example how variably this calcareous stratum is developed, and that, although its presence may be regarded as a proof of the identity of different outcrops of the coal, its absence is no proof of non-identity.

I have been informed that one and a half miles east of the corner of this county, in Hamilton county, at the south-eastern edge of Morse prairie, at Mr CHESTER JUDD'S, the limestone has been again found, in connection with the coal, in place of the calcareous slate.

Round the southern edge of Morse prairie, from Wilbank west to Gun-prairie creek, and also on branches of Sugar-camp creek, near the Franklin county line, sandstones are found at some points rather prominently developed, especially in the north-east quarter of section 33. There are also some shales exposed, but the coal has thus far escaped observation in this district.

## *Economical Geology.*

*Coal.*—The perusal of the foregoing description of all the noteworthy discoveries in the county, leads us to the inevitable conclusion that all the coal which is near the surface in the county, with the exception of that in the south-west corner, belongs to one stratum, which is in some places divided in two by a parting of shale, and which is the same that extends all over the adjoining county of Marion. The stratum at a few points exceeds one and a half feet in thickness, of good coal, and is frequently thinner. Where it is thicker, it generally contains impure portions. It is at many points of very good quality, and, as the country is broken, it can be profitably worked in numerous localities by stripping along the outcropping edges. It is therefore well adapted to supply the local demand for coal throughout the county, at a very moderate cost. In the introductory remarks, I have already stated that the coal and accompanying strata are neither horizontal nor dipping in one direction, but that they form waves which follow more or less the surface configuration of the country.

Now, the question arises, whether there is a lower coal-bed of greater thickness, at an available depth. The next lower coal-seam is that underneath the Shoal-creek limestone; but we have seen that this coal, where it is known on Little Muddy river, near the west line of the county, is too thin to pay the expenses of deep mining. This seam may become of some local importance in the south-west corner of the county, where it can be worked by stripping along its outcrops on a limited area; but, farther on, it is covered by a considerable thickness of the higher strata. The only remaining coal-bed of good promise, is then, the one which is worked in the coal-shaft at Tamaroa, on the Illinois Central railroad, at a depth of about two hundred feet below the surface, which is the same as the DuQuoin coal. Tamaroa is a little over four miles west of the south-west corner of the county; and it would therefore seem as if this coal-bed, in the nearest part of the county, could not be much, if any, deeper. I do not think so, however. My knowledge of these same formations in the adjoining counties, leads me to the opinion that this coal dips rapidly downward from Tamaroa, and in most parts of Jefferson county lies at a considerable depth.

It may be expected to be found at the least depth in the south-west corner of the county; but even there it would hardly be reached before going down several hundred feet.

The coal-vein near the surface at Central City is the same as the one near the surface in this county. I refer to what I have said on the subject in the above-mentioned report. If a great demand for coal should arise, I think this lower coal-bed might supply it. Its depth, at least, would not be greater than that of many coal-pits in other countries, and the only question would be as to its thickness, of which we can now only say that at Tamaroa it amounts to five feet eight inches.

*Minerals.*—The shales accompanying the coal-bed contain generally much kidney-iron ore—an impure carbonate of iron, in sub-globular concretions, or in flat bodies or sheets. The aggregate quantity of this ore is large, but it is probably not concentrated at any one point in sufficient quantity and of sufficient purity to be for the present of practical value for the production of iron. Some pieces of galena have been found scattered over the country, such as occur in the drift in many other counties of our State.

*Mineral Waters.*—The water in some parts of the county is impregnated with salts, orignating principally from the decomposition of the sulphuret of iron contained in the coal or shales, and from the action of the sulphate of iron thus produced upon the strata which it percolates. Thus other and more complex combinations of salts are formed, such as magnesia salts, alums, etc. As the coal-seam is near the surface in many neighborhoods, wells are frequently sunk down to it or to the accompanying strata, and this well-water contains these salts in variable quantities, which are often sufficiently large to prevent the use of the water for household purposes. Thus we find it, for example, at Mount Vernon, at Rome, in some parts of Morse prairie, especially at the Stone-coal branch, and at other places.

The strongest mineral water which has come to my notice in the county is from the springs of Dr. WILLIAM DUFF GREEN, at the south-eastern edge of the town of Mount Vernon. There are several of them. They issue from the side of a shallow ravine, at the same level, a few feet from each other, from a highly ferruginous stratum, which is apparently the slaty shale, with the iron ore above the coal-seam, here changed beyond recognition by the long-continued influence of the mineral water. These springs all contain a considerable quantity of iron, combined with other salts. It is remarkable that the water of all of them is not quite the same. The difference consists, however, principally in the relative quantity of the salts. The springs evidently emanate from the same stratum; but, passing through different portions of the rock, the water may come in contact with slightly different mineral substances.

The temperature of the running springs is the mean temperature of the earth in this latitude, or, what is the same, that of a deep, cool cellar; but one spring, which is by Dr. **Green** called "Tepid Spring," differs from the others in various respects. It is warmer than the others, at least in summer, because, not running as freely as they do, its water is stationary, and assumes the temperature of the air. It is said not to freeze in winter, which is apparently not a consequence of intrinsic heat, but of its saline character. Its water has a milky hue, because the iron salts which it contains begin to decompose in the orifice of the spring, where they are long exposed to the oxydizing influence of the air, without being discharged. Such is the simple explanation, based on the teachings of science, of some facts which have been regarded as wonderful mysteries. Nature's works seem mysterious, but all conform to definite laws, which, when the principles are once understood, appear plain and clear as daylight. A small quantity of gas is evolved in the springs, either through the action of the sulphates upon carbonates in the strata, or perhaps altogether by a vegetation of a low order, which rapidly grows and coats the orifice of the springs, and, under the direct action of the sun's rays, exhales oxygen.

Although originally similar, the waters of these different springs very probably have a different medicinal effect upon the system.

*Building Materials.*—Sandstone for foundations, the walling of wells, and for all ordinary and heavy masonry, can be readily obtained in nearly all parts of the county. Good quarries are already known in large numbers, and with little labor many new ones might be opened in convenient locations, as sandstones form the principal substrata of the county.

The limestone, the different localities of which have been enumerated in the above report, is generally impure, silicious or argillaceous. At some points it can, however, be burnt and used for making mortar, which has been done in former years. If the demand was sufficient, better quarries might be opened, and a better article might be obtained. At the present time most of the lime is shipped from a distance.

The fossiliferous, slaty limestone, or calcareous slate, is undoubtedly a superior fertilizer, but has not yet been used as such. Its wide distribution over the county will render it valuable in future times.

Brick may be manufactured wherever needed; and of fine timber of various kinds, white-oak, black-oak, post-oak, black-walnut, etc., there is an excellent supply.

*Agriculture.*—The soils in this county are similar to those of the adjoining (Washington) county, especially in its western portion, where the same geological formation prevails. I may refer to what I have stated in my report of that county. The white under-clay, which is such an unwelcome feature of some of the prairies along the Ohio and Mississippi Railroad, hardly any where extends into Jefferson county. This is a decided advantage to the fertility of the [illegible] generally good. The prairie lands [illegible] extensive [illegible] the other lands.

The [illegible] of the [illegible] generally more rolling, covered with a [illegible] growth of timber, and [illegible] well adapted to the cultivation of grain and [illegible] Some portions of the [illegible] are still thinly populated, but the advantages which the [illegible] will necessarily soon attract a large and [illegible] population [illegible]

# CHAPTER XIII.

## COOK COUNTY.

BY HENRY M. BANNISTER.

Cook county is bounded on the north by Lake county, by Lake Michigan and the State of Indiana on the east, by Will county on the south, and on the west by Kane and DuPage counties. It embraces a superficial area of nearly twenty-five townships, or about eight hundred and ninety square miles. It is of an irregular shape, the main body extending north and south along the shore of Lake Michigan, but having at its northern extremity an area projecting westward, including townships 41 and 42, in ranges 9, 10 and 11 east of the third principal meridian. That portion of township 37, range 11, lying south of the Des Plaines river, forms another less extensive westerly projection.

The principal streams in this county are the Des Plaines, which traverses it in a general north and south direction, and the Chicago and Calumet rivers, emptying into Lake Michigan. These, with their tributaries, and one or two minor streams in the north-western part, emptying into Fox river, drain every portion of the county.

The proportion of prairie to wooded land in this county is a little greater than two to one. The timber is distributed in belts, of varying width, along the water-courses and on the shore of the lake, with frequent groves or timber islands in the open prairie. In many places, however, much of the original forest has been cleared away, and the process of denudation of timber is still going on.

The surface of the country is generally level or gently undulating, the latter character prevailing in the northern and south-western portions of the county, becoming more broken and even hilly in the extreme north-western and south-western parts. The hollows between the undulations are often marshy, and occasionally contain deposits of peat of greater or less extent. The central and south-eastern portions of the county are mostly level, consisting of nearly flat, and in some cases marshy, prairies, with occasional groves and belts of timber.

The soil of the prairies is usually a black or dark brown mould, varying from one to four feet in depth, and is underlaid by a lighter colored sandy or gravelly clay subsoil. In the dry timbered tracts this subsoil comes very nearly to the surface, and generally throughout the county supports a growth of black, white and red oak, butternut, black walnut, bitternut and shell-bark hickory, cottonwood, etc., with an undergrowth chiefly of hazel. In the damp woodlands of the central portion of the county, we find, in addition to the above species, burr-oak, elm, black ash, and locally sassafras, forming a considerable proportion of the timber. On the sandy ridges which skirt the shores of Lake Michigan, the timber is almost entirely composed of the different species of oak, black, white, yellow, red and burr, with an occasional clump of red cedar or white pine, with cottonwood on the edges of the narrow sloughs which separate the ridges. The soil of these ridges is probably the poorest for agricultural purposes in the county, for, though warm and quick, it is light and easily exhausted, and from its sandy nature is most quickly affected by drought.

The surface deposits in Cook county consist of the Drift proper and subsequent alluvial and lacustrine deposits. The former, consisting of blue clay and hardpan, becoming locally brown and yellow, with numerous boulders, covers most portions of the county to the depth of from ten to eighty feet, or even more, and is overlaid at various points by the more recent lacustrine deposits of the Terrace epoch. Of the more ancient geological formations, we find in this county only the outcrops of the limestones of the Niagara group, which attains here, as well as we can estimate, a thickness of nearly three hundred feet.

## *Surface Geology.*

It is evident, with very little observation, that at a comparatively recent period, subsequent to the Glacial epoch, a considerable portion of Cook county was under the waters of Lake Michigan, which at that time found an outlet into the Mississippi valley through the present channel of the Des Plaines. The deposits of this period consist of beds of stratified sand and gravel in the central and eastern portions of the county, either underlying the flat prairies or arranged in the form of ridges, skirting the shores of the lake, and in one or two cases trending westward away from it to a distance of several miles. One of these ridges, which runs in a general east and west direction, is well seen on the road between Thornton station and the village of Old Thornton, in the southern portion of the county. It extends through the whole southern tier of sections in township 36, ranges 14 and 15 east, beyond the limits of the county and State, crossing the State line at Lansing station, on the Chicago and Great Eastern railroad. Another westward spur from the lake ridge is seen on the road running westward from the village of Grosse Point, in the southern tier of sections, towns 41, ranges 12 and 13 east. Still other sand ridges may be observed running in a general north and south direction, but at a distance of even seven and nine miles from Lake Michigan. These latter are not generally very prominent, and are better recognized by the change in the nature of the soil and vegetation than by their elevation above the surrounding surface. The westernmost of these passes through the village of Oak-Ridge, and running in a direction west of south, crosses the Chicago, Burlington and Quincy railroad a few rods west of the depot at Lyons, and is lost in the slightly rolling country, after crossing the Des Plaines river.

These ridges seem to me to indicate the shores of the ancient bay, which with these boundaries, would require the level of Lake Michigan to be nearly forty feet higher than at the present time. The outlet was evidently near the summit, where the Illinois and Michigan canal passes, and where at the present time an alteration of the level for a very few feet would send the waters of the Chicago river into the Des Plaines. Another very evident outlet, to the south of this, was through the channel now utilized by the Calumet feeder, joining the Des Plaines at the Sag, about four miles north of Athens village. The mound, or ridge, at Blue Island may probably be referred to this level of the waters. The evidences of a powerful stream are numerous on the rocks at Athens, in the shape of water-worn surfaces, pot-holes, etc. The nearer ridges, running parallel to the present coast line, would appear to indicate a very gradual recession of the waters of the lake, before reaching its present limits.

The structure of these ridges is similar to that of beach deposits, generally consisting of irregularly stratified sand and gravel beds, with sometimes a thin seam of vegetable mould. This structure is well displayed on the lake shore, north of the University grove, at Evanston, where the wearing action of the lake storms upon the shore has cut down one of the ridges upon which the town is built. The following section, with which I am favored by Prof. MARCY, of that place, was taken with great care, and is of especial interest as showing evidences of changes in the relative levels of land and water during this period:

| | | |
|---|---|---|
| 1. Surface soil | 1½ | feet. |
| 2. Fine sand | 2½ | " |
| 3. Coarse sand | 2½ | " |
| 4. Fine sand | 2 | " |
| 5. Gravel | 1½ | " |
| 6. Fine sand, containing tree trunks, etc | 1½ | " |
| 7. Dark colored marly bed, the lower part peaty | 1½ | " |
| 8. Fine sand | 3½ | " |
| 9. Blue clay, (drift) | 3½ | " |

In addition to the beds given in this section, there may be seen at one or two points, a thin seam of vegetable mould, resting immediately on the blue clays of the drift, and at the base of the true lacustrine deposits. In this seam there have been found many pieces of wood and stems of small trees, apparently cedar, and, in one instance at least, the stump with the roots penetrating the clay below to a depth of two or three feet, evidently in the position of its natural growth, thus showing that the land was at that time sufficiently elevated to support trees. Water-worn pieces of wood, also apparently cedar, are quite frequent in the stratum of sand above the clay, (No. 8 of the section).

The bed No. 7 of the section, may be followed for upward of half a mile along the beach, and is also frequently met with in digging wells in the town. An occasional fragment of bone, and a great abundance of fossil fresh-water shells are found in this bed. The shells are all of existing species of *Unio*, *Pisidium*, *Physa*, *Lymnea*, *Planorbis*, *Valvata*, *Amnicola*, *Melantho*, *Ancylus*, etc. Immediately above this bed, and generally resting upon it, in the stratum of sand No. 6, we find many stems of large trees, chiefly oak, which seem to have drifted to their present resting place as the waters of the lake gradually encroached upon the marsh.

In the eastern part of the county, along the lake shore, we often find the black surface soil of the small wet prairies underlaid by a bed of quick-sand, containing fresh-water shells of the genera *Melania*, *Unio*, etc., which belong to the same period as the lake ridges. Instances of this kind of prairie may be observed along the lines of most of the railroads running southwestwardly from Chicago, and on the Milwaukee railroad running north. Indeed, such prairies may be seen at the present time, in the process of formation, at various points along the lake shore in this county and elsewhere. The bed No. 7 of the section was probably deposited under conditions very similar to those of the formation of these prairies, in the bottom of a shallow lagoon or marsh, and serves to show how gradual was the process of submergence or emergence, during which it was formed.

The ridges which are cut off by the lake strike the shore at a small angle, and from their direction we are able to judge of the trend of the coast in former times, and it appears that a large territory, probably many square miles in extent, has been washed away by the wearing action of the lake waves. At the present rate of wear, which at the greatest estimate, and at the most exposed points, is but a very few feet annually, it must have taken many hundreds and even thousands of years to wear away this territory, the lake being at or very near its present level.

The deposits of the drift in this county consist, as has been already stated, of blue clays, becoming locally brown and yellow, and hard-pan containing frequent boulders, with now and then a thin seam or irregular stratum of sand or gravel. They probably at one time covered the country to a much more uniform depth than at present, but subsequent eroding agencies have so modified the surface that it now ranges from twenty to eighty or a hundred feet in thickness in different parts of the county. Outside of the city of Chicago we have hardly any data for ascertaining the exact thickness of this formation, as wells seldom penetrate it to any considerable depth, and there is rarely any journal or record kept of the digging. It is probably thinnest west and south of Chicago, as the rocks appear to be nearest the surface in those directions. In boring the artesian well at the Union stock yards, south of the city, it was found to be only about forty-five feet in thickness, and at the rolling mills in the northern part of the city, seventy-six feet of the clays of this formation were passed through. At Athens and vicinity the bluffs will average near eighty feet, or even more, above the uppermost exposures of the Niagara limestone, which is probably not far from the real thickness of the drift in that region. In the northern part of the county, though wells have been dug forty, fifty, and even seventy feet, I am not aware that any have passed through the drift to the formations below.

In the upper part of the drift there is often an appearance of stratification, especially in the vicinity of the larger streams. In the northwestern part of the county, in townships 41 and 42, range 9 east, lying near the Fox river, a very noticeable feature is a stratum of water-worn boulders and pebbles, chiefly of limestone, but with an occasional hard-head (boulder) of granite, hornblende rock, etc., which crop out on nearly all the hillsides, in some places strongly resembling a natural outcrop of a limestone bed. In the clays and hard-pan of the older drift, we often find in this county the finer and more homogeneous stratum in the upper portion. In the section afforded by the above shaft of the Chicago lake tunnel, after passing through the more recent beds of stratified sand and gravel, we find some thirty feet of fine blue clay, underlaid by what is described as "greenish hard-pan," containing numerous boulders and angular fragments of rock. The same arrangement of finer clays, underlaid by coarser hard-pan, is to be seen in various sections afforded by the lake-shore bluffs, at and near Wynetka, in the northern part of the county, but the line of division between the two is not generally very distinct.

An interesting feature, which has been noticed by Dr. ANDREWS, in the American Journal of Science, and by Dr. JEWELL, in his report to the Chicago Academy of Sciences, on the lake tunnel, is the presence of pockets, or irregular beds of sand and gravel, sometimes stratified, occurring here and there, without any regularity, in the clays and hard-pan of the drift. These masses of gravel and sand were accounted for as having been taken up from beach or bar deposits, while in a frozen state, by moving bodies of ice, during the glacial epoch, and deposited in their present resting-places with the finer sediment which formed the clay. However, as these gravel beds form the channels by which water traverses the otherwise almost impervious clays, it is possible that, in some cases, they may be due to its action, or, at least, have been considerably modified by this agency.

With the exception of such as may be found in fragments of rock derived from the older formations, these lower clays, in this county, appear to be almost entirely destitute of organic remains. In one or two instances only has there been observed what appeared to be fragments of decayed wood.

Scratches, such as are usually referred to glacial action, occur on the surface of the underlying rocks, at several places in this county. I have observed them on the limestone beds in the vicinity of Blue Island, and at the village of Old Thornton, on pieces of the rock which had been quarried out. In the former place their direction was due north and south (magnetic), and at the latter, as nearly as could be learned of the position of the pieces *in situ*, from north by north-east to south by south-west. In most places, however, the exposures of rock are not such as will show the striæ well.

Some peculiar surface-markings, which are found on some of the upper layers in the Athens quarries, are deserving of mention here. They consist of parallel groves, sometimes extending over a considerable surface, and generally trending in a direction parallel to the course of the river (Des Plaines) valley, from north-east to south-west. They have been enlarged by the action of running water, and are very irregular in their outline. These have been referred to glacier action, which, however, seems hardly probable, when their position in the bottom of the river valley is considered. It seems to me more probable that the river channel and bottom have been excavated subsequent to the drift epoch proper.

Although, as has been already stated, only the limestones of the Niagara group appear in the surface outcrops in this county, we yet have a complete section of the underlying rocks, afforded by the artesian wells which have been bored in the city of Chicago and its immediate vicinity. Of these the deepest, and in some other respects most satisfactory for geological information, is the boring at the Union stock yards, south-west of the city, which passes through all the strata from the upper portion of the Niagara group to the lower magnesian limestone. The record was kept by Mr. JOHNSTON ROSS, who superintended the boring. The whole depth penetrated was eleven hundred and five feet, and after about forty-six feet of drift and surface deposits, the strata were passed through in the following order:

| | | |
|---|---|---|
| *Niagara Group—254 Feet.* | | |
| 1. Bluish-gray limestone | 16 | feet. |
| 2. Light-gray limestone, slightly varying in shade of color at different depths | 138 | " |
| 3. Limestone (nearly white) | 20 | " |
| 4. Limestone (buff or drab) | 80 | " |
| *Cincinnati Group—250 Feet.* | | |
| 5. Shale (soft and fine) | 104 | feet. |
| 6. Limestone (light-gray) | 20 | " |
| 7. Shale (coarser and arenaceous) | 126 | " |
| *Trenton Group—330 Feet.* | | |
| 8. Brownish ferruginous limestone | 25 | feet. |
| 9. Grayish limestone (more or less dark) | 305 | " |
| *St. Peters.* | | |
| 10. Whitish-brown sandstone | 155 | feet. |
| *Lower Magnesian Limestone—70 Feet.* | | |
| 11. Light-colored limestone (very hard) | 60 | feet. |
| 12. Gray limestone | 10 | " |

The strata are most probably horizontal, or nearly so, and the section, therefore, gives very nearly the true thickness of each bed. The thickness here given of the Cincinnati group, two hundred and fifty feet, is greater than is generally allowed, but this, perhaps, is only a local difference.

*Niagara Group.*—This formation, as far as can be ascertained from the outcrops of rock, underlies the whole surface of the county. In the northern part, however, exposures of rock are scarcely met with; indeed, all of the outcrops in the county, with, perhaps, one exception, are included in that portion lying south of the north line of township 39, ranges 12, 13 and 14 east. To the northward of this limit the country is covered with a heavy deposit of drift; but this is, in all probability, underlaid by the same beds of Niagara limestone as farther south. The nearest outcrops in the adjoining counties are of that age.

We find the study of the Niagara group, as it is developed in this county, somewhat difficult, not only on account of the infrequency of exposures, but also because of the lack of good natural sections. By means of the artesian well section, however, we learn that its thickness in the vicinity of Chicago is not far from two hundred and fifty feet. There are also certain strata occurring in the southern and south-eastern portions of the county, which do not appear to have been passed through by the Chicago borings, and which are probably still higher in the formation. Add from thirty to fifty feet for the thickness of these to the amount afforded by the artificial section, and we have an aggregate thickness of this group in the county of from two hundred and eighty to three hundred feet. The exposed thickness, however, is somewhat less, as the lowermost beds do not come to the surface within the limits of the county. The dip of the strata appears to be mainly to the south and east, thus bringing the uppermost beds to the surface in the southern and eastern portions of the county. The principal outcrops, commencing at the (supposed) upper beds, are as follows:

About a mile and a half east of Bloom village, near the line of the Joliet cut-off of the Michigan Central Railroad, in the south-west quarter of section 22, township 35 north, range 14 east, there occurs an outcrop of these strata in the bottom and sides of a small stream. The exposure is only of about six feet, of a light-gray, fossiliferous limestone, weathering to a yellow or buff color, of a decidedly concretionary structure, and showing stratification very imperfectly. The rock is in many places stained with bitumen, and contains cavities filled with the substance in a semi-liquid condition, though, in the rock itself, the more volatile part appears to have mostly evaporated, leaving only a black stain, or in some instances particles of dark, coaly-appearing matter. The outcrop appears to be on a ledge or upheaval, which extends for nearly two miles in a general north-east and south-west direction, having a breadth of from a quarter to half a mile. The rock is exposed, however, at but a few points, being elsewhere covered with soil to the depth of a foot or more. The most southerly outcrop lies about a quarter of a mile south of the railroad, and is of very limited extent.

Somewhat more than a mile north-east of the first-mentioned locality, in the north-west part of section 23, at Miller's lime-kiln, the same beds are quarried for lime, and present a precisely similar appearance. The bituminous character of the rock is evidenced by a very perceptible odor during the process of burning the stone in the kiln. Just north of the kiln, at the bottom of one of the excavations, there appears an impure buff-colored stratum, with a little of a bluish tinge where it is least weathered, and having somewhat the appearance of a hydraulic rock. The exposure, however, is too limited for a thorough examination, and nothing could be learned of any practical test as to its qualities, excepting the statement that it would not slake after burning in the kiln.

Immediately north of this locality, the ledge disappears under the drift, and no exposures of rock are met with within several miles of this point. The nearest occurs in the south-eastern quarter of section 4, in the same township, where the bed of Thorn creek, for a few feet, is composed of an impure bluish limestone, containing what are apparently traces of fucoids.

In the quarries at Old Thornton, the strata have a strong dip, varying from ten to twenty degrees, to the south-east, and by this a considerable thickness of the strata is exposed. The exposures, however, are not continuous, and it is not easy to ascertain the exact amount, but perhaps about seventy-five feet will be a sufficiently low estimate. The uppermost beds exposed here, appear on the west bank of Thorn creek, about two hundred yards above the bridge, and are probably equivalent to the beds exposed at Miller's, though differing somewhat, lithologically. The rock is a massive gray limestone, rather dark in color, and more compact than the rock in the above mentioned locality, but like it in being highly fossiliferous, and bearing identical species of *Pentamerus*, *Favosites*, etc. In the quarries nearest the bridge, the rock is a yellowish limestone, showing a light gray color on freshly-fractured surfaces, and, with the exception of silicified corals, the cavities of which are frequently filled with bitumen, apparently destitute of fossils. From the direction of the dip at these two exposures, about south 40° east, it is evident that there is a considerable thickness of intermediate strata which is not exposed.

In the quarries in the village, the rock is similar to that at the bridge, the lowest beds, perhaps, rather darker colored, but are much fuller of traces of organisms, though well preserved fossils are not abundant. Bitumen stains are abundant throughout the rock, and masses of this mineral, in color and consistency resembling cold pitch, are occasionally met with. At Leavitt's quarry, the easternmost of the excavations at this point, the rock changes to a blue, or bluish gray, impure limestone, probably identical with that before mentioned as occurring in the bed of Thorn creek, in section 4, township 35, range 14.

When weathered, its color changes to buff, the change not limited to the surface, as in ordinary cases of weathering, but extending inward, often for two or three inches or more, according to the length of time that it has been exposed. About ten feet of this bed is exposed in the quarry. It is underlaid by strata similar to those worked in the excavations to the west, which are also beneath it in position. It is probably intermediate between them and the gray fossiliferous limestone, which outcrops on the creek a little farther east. In the lower part of this bed, near its junction with the strata beneath, we find many fine silicified corals, such as *Favosites*, etc.

Throughout the village, and for a mile or more in the directions north and north-west, the rock appears to be very near the surface, covered for the most part with only a thin stratum of surface soil. The finer materials of the drift deposits, which once covered this tract, have been washed away, leaving the surface strewn here and there with the larger boulders of granite, quartzite, etc. The whole extent of territory thus underlaid is between one and two square miles, and occupies portions of sections 27, 28, 33 and 34, in township 36, north, range 14, east. It is slightly elevated above the adjoining prairie, and on its northern slope, near the section-line between sections 27 and 28, and farther west, the rock again appears at the surface. It is here a light gray limestone, apparently of a somewhat concretionary structure, and at one point, close to the road from Thornton to Blue Island, there appeared to be a strong dip, nearly 20° to the north-east.

The nearest locality to this place, where any rocks occur which can be identified with the Thornton beds, is in the north-western part of section 1, township 36, range 13, about a mile south-west of Blue Island, and distant from Thornton, in a north-westerly direction, about seven miles. Here, a bed of bluish, impure limestone, to all appearances identical with that occuring at Thornton, is worked as a hydraulic rock. Only the bluish strata are uncovered at this point, but some of the uppermost layers have been so changed by weathering as to present an entirely different appearance from the more recently worked beds below. A few fossil shells, *Orthocerata*, etc., have been obtained here, and fucoidal (?) traces are especially abundant. The dip here is very slight, 2° to 4° to the south-east; indeed, the prairie for more than a mile to the south-west of this point, appears to be underlaid by this rock very near the surface; but in this case, the strata being very nearly horizontal, there is no very apparent elevation above the surrounding country.

One mile farther to the south-west, at the place of Mr. Henry Schwartz, in the south-east part of section 2, this bed is again quarried, and presents a similar appearance. About three miles west of this place, in the south-east quarter of section 5, on the land of Mr. Smith, there occurs an outcrop of limestone, on the banks and bed of a small stream. The rock here is regularly bedded limestone, of a light gray color, where not weathered, and is very fossiliferous, although the fossils, for the most part, are only casts, and quite imperfect. At the eastern end of the outcrop, the layers have a slight dip to the south-east, but a few rods farther back are horizontal. This rock is probably underlaid by the bluish hydraulic limestone, which outcrops farther east, and, in this case, would be the equivalent of the upper strata at Thornton, and those exposed farther south, at Miller's. The fossils are identical in each case, and one species, the *Pentamerus Knightii*, especially abundant in, and common to, all these localities, has not been found by me in any outcrops throughout the county. It seems to occur only in the beds overlying the bluish hydraulic rocks, which, as they do not appear to have been passed through by the Chicago borings, I have assumed to be the upper portion of the Niagara Group, as developed in this county.

Along the eastern border of the county, north of the points already mentioned, the county is generally low, and exposures of rock are not numerous. The southernmost point where rock appears at the surface, is in the southern portion of section 1, township 37, range 14, where a bed of gray, fossiliferous limestone has been quarried. An area, equal to nearly half a section, is here underlaid by this limestone, covered only by a slight thickness of surface soil. Still farther north, in the eastern part of section 30 (fractional), township 38, range 15, the same rock occurs, but is here completely saturated with petroleum. The exposure is on the edge of one of the sand ridges bordering the lake shore, and consists of excavations of limited extent, made in former times, when the rock was quarried for the manufacture of lime. It is reported, also, that rock occurs in the bottom of the lake, near the mouth of the Calumet. I had no means of ascertaining the truth of this myself, but if so, it is probably a part of the same bed which appears in these nearest outcrops on land. North of this point, no exposures are met with until within the limits of the city of Chicago.

In the southern part of the city, in the quarter known as Bridgeport, a gray fossiliferous limestone is extensively quarried for the manufacture of lime. It here presents some peculiar features, being a massive concretionary rock, showing very little appearance of stratification, and varying in structure from a loosely compacted clayey rock to a solid bluish-gray limestone. This locality is especially rich in organic remains, and has yielded very many species of the fossils of this formation. The same beds occur again at a point near the track of the Chicago, Burlington and Quincy railroad, about a mile and a half northwest of this locality, where they are likewise extensively quarried, and present similar characters. There is, however, a little more appearance of stratification, and the beds appear to have a slight and very irregular dip to the north-east. North of this, at the western terminus of Chicago avenue, are the artesian well quarries, where the limestone is completely saturated with petroleum. The presence of petroleum in such quantity in this outcrop, may be only a local peculiarity, and in other respects its lithological characters are similar to those of the previously mentioned exposures in this vicinity; but there is, nevertheless, some doubt as to whether it can properly be identified with them. The scarcity and almost total lack of good fossils in this quarry is in striking contrast to their abundance in the other localities. If it is not the same bed it is most likely either immediately below or immediately above; the latter seems most probable, from the direction of the apparent dip.

West of Chicago, the nearest exposure occurs at Swagey's lime-kiln, in the south-west quarter of section 27, township 39, range 18, nearly on the line between sections 27 and 28, and four miles, in a direction about north 8° east, from Lyons station, on the Chicago, Burlington and Quincy railroad. The rock in the quarry here is a regularly-bedded gray limestone, weathering yellow—a little darker in color than the average of the Chicago rock. The strata here dip strongly in the direction south 50° east, the angle varying from ten to thirty degrees. By means of this strong dip, nearly forty feet in natural thickness of the strata is exposed. As is usually the case in the limestones of this group, some portions of the rock appear to be entirely made up of organic remains in almost undistinguishable fragments; nevertheless, well preserved fossils are extremely rare.

West of this point, for some distance, the indications on the surface are that the rock is not far below; but it does not appear above ground till we reach the Des Plaines river at Lyons, distant about four miles, in a nearly west by south-west direction. It seems probable that there is here a low anticlinal, with its steeper slope on the southern sides, and with a strike at first about west of south-west, but after the crossing of the Des Plaines, bending more to the southward, until it is lost under the accumulations of drift in that direction. The course of the Des Plaines is abruptly changed by this obstruction, when, coming from the north, through the Quaternary deposits, it first strikes the limestone of this ridge and bends suddenly to the north-east for about three-fourths of a mile; then, taking another sharp angle, runs about south of south-east for a mile and a half; after which it continues in a general south-westerly direction, through the ancient river channel by which the waters of Lake Michigan were discharged into the Mississippi valley. This disturbance of the strata may be traced by means of scattering exposures and surface indications, for about four miles beyond the crossing of the Des Plaines at Lyons. Beyond this, the surface appearances cease, and outcrops are scarcely met with.

On the western bank of the Des Plaines, at Lyons, near the crossing of the wagon-road from Chicago, a disused quarry shows beds of gray limestone, apparently the same rock as that which occurs farther east, dipping irregularly to the south-east and east south-east, at an angle of from ten to fifteen degrees. As, in the before-mentioned locality, good fossils seem to be rare, though the rock on weathered surfaces often shows an abundance of fragments of crinoidal stems, etc. At the two other quarries in the village the rock differs from that at this point. About half a mile nearly west of this place, and also near to the river, a light-gray or grayish-white porous limestone is quarried for the manufacture of lime. No fossils were found in this quarry, nor was any regular dip observable. About a quarter of a mile south-east of this point the rock is again exposed in an abandoned excavation. It is here apparently a coarse yellowish limestone, showing scarcely any stratification whatever, and is very fossiliferous. The fossils collected here were of two or three species of *Pentamerus*, *Pleurotomaria*, etc. These three exposures in the village are entirely disconnected, and it is not possible to exactly ascertain their relative positions. On the banks, and in the bed of the stream also, the river *debris* has so covered the rock that the particulars of dip, strike, etc., can not well be obtained.

In the south-eastern quarter of section 11, township 38, range 12, a massive gray limestone, in many respects strongly resembling some of the Lyons rock, is quarried. No regular dip was observed here, and the limestone appeared to be altogether barren of fossils. The whole thickness exposed is only about six feet, about two feet in thickness of the upper portion appearing of a buff or pale-yellow color, most probably from weathering. About a mile south-west of this, in the north-eastern part of section 15, on the open prairie, gray limestone appears in the bottom of ditches and natural water-courses, and also upon the surface of the ground. In one place, where the rocks had been slightly excavated so that the dip could be taken, it was found to be between east and south-east, and amounting to from ten to fifteen degrees. The rock at this point is quite fossiliferous, the species mostly identical with those from the quarries in the city of Chicago. The species collected at this locality were *Acidaspis Danæ*, *Illænus insignis*, *Meristella nitida*, *Atrypa reticularis*, *Stroph. rhomboidalis*, *Stroph. Niagarensis* (?), *Leptæna transversalis*, *Caryocrinus ornatus*, *Eucalyptocrinus*, probably *E. decorus*, fragments of a *trilobite*, apparently *Calymene*, and others. About a quarter of a mile farther to the southward, in an adjoining field, is another excavation of limited extent, which has yielded some large *Orthocerata* and *Lituites*.

At Mr. HARRISON'S place, still farther to the south-west, and about three miles from Lyons village, is a more extensive quarry. The limestone here is regularly bedded, the layers horizontal or nearly so, of a yellowish-gray color, and showing on weathered surfaces a great abundance of undetermined crinoidal remains. Complete and well preserved fossils, however, are not abundant. This rock appears quite suitable for building purposes, though the layers do not generally appear to be very thick. Mr. HARRISON'S house and barn are built of it. The only prominent outcrop to the south-west of this place, till we reach the county line, occurs on the land of Mr. THOMAS COOK, in the south-east quarter of section 19, township 38, range 12, where a ledge of yellowish-gray limestone is to be seen, in the field on the south-east side of the road. It is also said to occur in the bottom of a hollow in a field on the opposite side of the road, but was covered up at that point at the time of my visit.

It is possible that what has been called an anticlinal in the foregoing pages may prove to be an upheaval, with a fault, or a sudden drop to the southward, in the strata. None of the exposures on the line of disturbance show any decided dip to the north-west; the beds, wherever stratification is apparent, either dipping to the south-eastward or apparently horizontal. On the western side of the Des Plaines, however, in some places, surface appearances seem to favor the theory of an anticlinal. Throughout its whole extent this disturbance borders, on the north-west, the least elevated portion of the county, the ancient river channel of the Terrace epoch, and its western limits are generally hidden under the accumulations of drift material, to which the elevation of the surface to the northward and westward is mainly due.

North of this line of disturbance outcrops of rock are few and scattering. One of these occurs near the residence of Mr. FRANK COVELL, in the north-east quarter of section 17, township 39, range 12. The outcrop is of a grayish limestone, weathering to a dark-buff or brown color, the upper portion apparently somewhat decomposed and crumbling. No fossils, except imperfect crinoidal remains, were discovered. Another outcrop occurs about a quarter of a mile south-west of this point, and it is probable that the slight eminence above the surrounding prairie, on which these outcrops occur, is due to limestone strata lying not far below the surface. Nearly three miles due south of this, on the south line of section 29, limestone again appears, on the banks of Salt creek. The rock is, as usual, of a light-gray color on freshly fractured surfaces, but turns yellow after weathering. It has been quarried here to a very limited extent, and furnishes some fossils, among them very large specimens of *Pentamerus oblongus*, and a few corals and crinoids. The same rock, apparently, occurs in the bed of the creek as it enters the county, in the north-west corner of section 31.

A doubtful locality of rock is in the western part of section —, township 42, range 12, on the land of Mr. MILO WINCHELL. Here it is reported that, in the years 1856 and 1857, limestone for the manufacture of lime was obtained; but, that on account of the supply failing, the work was afterwards given up. The excavation is of very limited extent, and, at the time of my visit, was so filled up with mud and water, that no rock was visible. It is highly probable that this was a mere isolated mass, or boulder, of limestone, of large size, and not a bed of rock *in situ*.

The principal exposures of rock which remain to be mentioned in Cook county, occur in that portion of township 37, range 11, which is included within its limits, and comprise the quarries and outcrops at Athens, and above, on the Des Plaines river and the canal. The upper beds at Athens are cherty, the chert distributed in nodules, between the thin layers of buff-colored rock; the nodules sometimes coalescing, so as to form a thin seam, or stratum, for a considerable distance, breaking off and renewing itself at intervals. These cherty strata can be seen at the foot of the bluffs, on the eastern side of the railroad

(Chicago and Alton), in the village, and are also well exposed, in their lower portion, in the upper part of the Illinois Stone Company's quarry. Though its whole thickness is not to be seen at any one point, yet the whole vertical depth of this stratum, from its uppermost exposures to where it joins the beds below, may be estimated as between fifteen and twenty feet. Below this, we find a compact, even-textured light-drab, or nearly white limestone, in regular beds or layers, the same material which, under the name of "Athens marble," is so extensively known and used as a building material in the city of Chicago and elsewhere. It is exposed in the quarries here to the depth of ten feet or more, and also forms the bed of the river and canal, at this place, for some distance above, and below to beyond the limits of the county. It also occurs at "the Sag," nearly four miles above, where there is also a quarry. This, at the time of my visit, was abandoned, and filled with water; but such of the stone as could be seen, appeared identical with that at Athens.

It is stated that the pot-holes, which have been already mentioned as occurring in the water-worn surfaces of the upper layers in the Athens quarries, when of sufficient depth to penetrate one layer and enter another, are occasionally found to be dislocated—that is, one layer has slipped upon the other; so that the upper and lower portions of the pot-hole are, in some cases, entirely separated from each other. I was not myself so fortunate as to observe a case of this kind, but the fact of their occurrence seems to be well attested. It would appear to indicate a slight disturbance of the strata, at a comparatively very recent period, subsequent even to the Terrace epoch, during which these holes were probably formed. The dip here is hardly perceptible, not more than one or two degrees to the south-east, in Singer and Talcott's quarries, where these appearances have been most observed—the disturbance is, therefore, very slight, and it is quite probable that it was also very gradual.

From only the scattered outcrops which have been enumerated in the foregoing pages, separated as they are by stretches of country more or less heavily covered with drift, it is impossible to, in all-cases, ascertain exactly their relative positions to each other, or the vertical range of the exposures in the formation. Sections taken beyond the limits of the county, however, seem to prove that the Athens rock is in the lower part of the series, probably within eighty or a hundred feet of the bottom, or even lower. It is probably the equivalent of the upper part of No. 4, of the Artesian well section, which has been given before. The only outcrops in the county which appear to me, by any possibility, to belong to a lower bed, are those occurring near its western border, in township 39, range 12, and, leaving these altogether out of the account, as doubtful, we have from one hundred and seventy to two hundred feet of vertical thickness between the uppermost and lowermost exposures. This, when we take into consideration the varied characters, both lithological and paleontological, presented by the different exposures, in many cases, at least, indicating entirely different strata, seems a sufficient low estimate.

Fossils are not equally abundant in all the beds of the Niagara group, and in many places the nature of the rock, a concretionary magnesian limestone, is unfavorable to their preservation. In some localities, indeed, well preserved fossils, or even tolerable casts, are very rarely met with, though the rock itself be entirely made up of undeterminable organic remains. Other localities, however, have yielded abundantly, and enough is given to show that in the variety and abundance of its remains of animal life, this formation is second to none of the subdivisions of the Silurian, which occur in this State. Of the species which have been discovered in this county, the following may be enumerated as occurring at Chicago, and other localities where the upper portion of the formation is exposed: *Favosites, Gothlandica, Diphyphyllum caespitosum, Halysites catenularia, Caryocrinus ornatus, Atrypa reticularis, Meristella nitida, Spirifer radiatus, Pentamerus Knightii* (?), *Strophomena rhomboidalis, Pleurotamaria gonopleura, Holopea Niagarense, Cyrtoceras Fosteri, Illaenus insignis*, etc., etc. Over eighty species have been enumerated by Professors WINCHELL and MARCY, from the Bridgeport locality alone, and there are other localities in the county which would probably yield nearly as well, were they as extensively worked. The lower beds, at Athens and vicinity, contain comparatively few fossils, and *Pentamerus oblongus*, which is so characteristic of the lower part of this formation, has been positively identified from but one locality in the county.

## *Economical Geology.*

*Building Stone.*—The supply of stone for building purposes is ample in Cook county, although its distribution is somewhat unequal. For this, however, there is a partial compensation, as by means of the numerous railroads centering in Chicago, the best materials in the county are easily accessible to all its parts. It is the lack of cheap material, for the rougher kinds of mason-work, that is chiefly felt in those parts of the county most distant from available stone quarries.

The lower division of the Niagra group affords, in the Athens quarries, one of the best building stones in the State. The rock is a fine-grained, even-textured limestone, of an agreeable, light-drab color, when first taken from the quarry, and rubs well, though not capable of receiving a very fine polish. It is regularly bedded, the layers ranging from six inches to nearly three feet in thickness, thus affording dimension and flagging stone of almost any required size. By exposure to the air, it changes to a pale yellow, or buff color, which appears to be deepened by the smoky atmosphere of a city; in some cases, so much as to materially injure its appearance. Its accessibility to Chicago, and its general excellence as an ornamental stone, have made it almost the only material used, at the present time, in that city, for facing outer-walls, and for general outside decorative architecture. From its adaptability to these uses, it has fitly received the name of "Athens marble," by which it is known wherever it is used.

The limestones occurring on the western banks of the Des Plaines, south-west of Lyons, furnish a good material for rough walls, and, when the beds are of sufficient thickness, answer well for general building purposes. The dark-colored bituminous limestone, which is quarried just west of the city limits at Chicago, is likewise used for the same purposes, for rough masonry, etc., in the city. The Second Presbyterian church is also built of this stone, which imparts to the edifice a peculiarty venerable appearance.

The upper beds of the Niagara group, which are found in the south-eastern part of the county, afford a good material for rough walls, culverts and flagging, and are somewhat used for buildings. The quarries at Thornton have furnished a considerable part of the stone used in the culverts, etc., of the Illinois Central Railroad in this county. The rock in most of these quarries is regularly bedded, the layers from six inches to a foot or more in thickness, and appears well adapted to the purposes for which it is used. The bluish, impure limestone, which has been mentioned as occurring in Leavitt's quarry at this place, cracks and breaks up under the influence of the frost, when first taken from the quarry, and needs to undergo the process of weathering before being used as a building or foundation stone. The same bed is quarried near Blue Island, and exhibits the same qualities; but there it is worked less as a building stone than as a cement rock.

*Lime and Cement.*—The beds of limestone outcropping in the southern half of Cook county afford an inexhaustible supply of material suitable for the manufacture of a good quality of quick-lime. The gray limestones of the upper part of the Niagara group, at Chicago and in its vicinity, are most extensively used for this purpose. In the lighter-colored limestones of this group, some selection must be made among the beds to obtain the material for the manufacture of good lime. In the extreme north-western portion of the county, where a band or stratum of worn fragments of limestone occurs in the drift deposits, lime-kilns are supplied with stone for burning by simply digging the boulders out of the hills. Mention has already been made of a bluish earthy limestone, which is quarried in the neighborhood of Blue Island for the manufacture of cement. The same rock is again met with in the village of Thornton, and at one or two points in township 35, range 14.*

*Clay, Sand, etc.*—The sub-soils and drift-clays of various parts of this county afford a good material for the manufacture of brick, and are extensively used for that purpose. In many cases, however, the bluish clays of the drift are too calcareous, or contain too many small limestone pebbles, disseminated through the mass, to be suited for the manufacture of good brick. This difficulty was met with in the construction of the Chicago lake tunnel, the clay taken from the excavation of which it had been intended to make the bricks for the lining of the tunnel, proving entirely unfit for the purpose. The finer kinds of clay, suitable for pottery or a superior quality of drain-tile, seem to be entirely wanting. Sand, for building purposes, is sufficiently abundant in all parts of the county.

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* For an analysis of this hydraulic limestone, see the appendix to this volnme.

*Peat.*—In various portions of the county deposits of peat are known to exist, and have, in some cases, been worked to a limited extent. None of the beds yet discovered occupy any large surface of country; they are, in most cases, of only a few acres in extent, and when of greater area are generally of very inconsiderable depth. The surface-soil of the more recently formed wet prairies, or sloughs, of the eastern part of the county, is often peaty, and occasionally a deposit of true peat, of a considerable depth, is found in these situations. Such a deposit may be seen at Rose Hill Cemetery, seven miles north of Chicago, on the Milwaukee division of the Northwestern Railway, in the south-eastern corner of which a bed of peat has been excavated to a depth of four or five feet. The whole extent of this deposit has not been ascertained, but in many places on the adjoining prairie this substance forms the bottom and sides of ditches, one or two feet in depth. Other deposits of peat occur in similar situations on the eastern border of the county, and in the small prairie sloughs of the interior, but have as yet received very little attention. It is highly probable that, when this article becomes of more economic value, very many more localities of it will be discovered in all parts of the county.

Deposits of fresh-water marl are sometimes met with in connection with peat-beds, or in very many similar situations. One such deposit occurs near the western border of Cook county, in the southern part of section 6, township 38, range 12, in a marsh which apparently was at one time a shallow lake. The marl here is covered by a thin layer of peat, and was discovered while making the track of the Chicago, Burlington and Quincy Railroad. The whole extent of this deposit is not known.

*Bitumens.*—The presence of petroleum and mineral pitch, in some of the beds of the Niagara group in this county, has been already mentioned. In two localities only the true petroleum has been observed, impregnating the rock and filling its cavities. These are, respectively, the western limits of the city of Chicago, and in the eastern part of section 30, township 38, range 15. Farther to the south still, on the eastern border of the county, we find bituminous limestones; but here the more volatile matters have escaped, leaving only nodules of mineral pitch, or, in some cases, merely dark stains upon the rock. The cavities of the large corals (*Favosites*, etc.), found in the limestone, are also often filled with bitumen.

It is only in the upper part of the Niagara group that these bitumens occur; the lower beds yield scarcely a trace of them. At Chicago the bituminous limestone was found to be only thirty-five feet in thickness, and below it hardly any traces of oil were met with till the boring entered the shales of the Cincinnati group, where the indications again appeared. Neither in the surface rock, nor in the shales, were there indications of oil in sufficient quantity to be of any economic value; nor does it seem probable, either from the lithological character of the bituminous limestones of the Niagara group, or from their posision as the uppermost rock in the county, that oil, in paying quantity, will ever be obtained from them. It is hardly possible, moreover, that oil, in larger quantities than have heretofore been discovered, will yet be met with in the lower formations, and the indications certainly do not warrant any expenditure in this direction.

The water-gas, or light carburetted hydrogen, which was met with in great abundance in the drift clays, during the construction of the lake tunnel at Chicago, may perhaps have been derived from underlying beds of this bituminous limestone.

*Minerals.*—The metallic minerals which are met with in this county chiefly occur in the materials of the drift, and are derived from more northern deposits. The only exceptions to this are, the iron pyrites, which is sometimes formed, in small quantities, in the limestones of the Niagara group, and bog-iron ore, deposits of which will probably be yet discovered in some of the marshes and peat-bogs, though whether it will be found in sufficient quantity to be of any economic value, is very doubtful. Another of the ores of iron which is found in the county is the black magnetic oxyd, or magnetites, small patches of which are frequently to be seen on the beach of Lake Michigan. As in other parts of the State, a piece of copper or galena is occasionally found in the surface deposits of this county, the latter, at least, probably brought to the place where it is found by human agency.

The soil of the upland prairies in this county agree, in general character and agricultural products, with that of other portions of north-eastern Illinois, and requires no especial mention in this report. We will only say in regard to it, that when thoroughly and properly cultivated, it is always productive. In many portions of the county, however, where the land is comparatively level, attention must first be given to a proper surface drainage. The narrow belt along the eastern border of the county, near the shore of the lake, where the surface is alternately sand-ridge and low prairie, is of course inferior, but has acquired in many places a much greater value from its availability for residence sites.

Before closing this report, mention must be made of the water supply afforded by the artesian wells in the city of Chicago. These wells range in depth from seven hundred to eleven hundred feet, and generally furnish an abundant supply of water for the local needs which caused them to be bored. The geological horizon from which the water comes is somewhat variable, as will be seen from the range in depth, including, probably, all the beds from the lower Trenton to the upper part of the Calciferous, or Lower Magnesian.

I must also here express my indebtedness to the Chicago Academy of Science, and to its Secretary, Dr. STIMPSON, for valuable assistance afforded while I was engaged in the field work of the Geological survey of this county.

# CHAPTER XIV.

## LA SALLE COUNTY.

BY H. C. FREEMAN.

This county is bounded on the north by Lee and DeKalb counties, on the east by Kendall, Grundy and Livingston, on the south by Livingston, Woodford and Marshall, and on the west by Marshall, Putnam, Bureau and Lee. It embraces an area of thirty-two townships, or about 1152 square miles. Its surface, mostly prairie, is undulating, and generally well drained.

The Illinois river runs nearly centrally, in a west course, through the county. Its principal tributaries in the county, are Fox river, Big and Little Vermilion rivers, and the smaller ones, Pequamsoggin, Cedar and Covel creeks, and Clark's run.

There is, besides the undulation of the surface of the prairie, a considerable descent toward the Illinois river. The difference of level between the city of LaSalle, at the Illinois Central Railroad station, and Mendota, is two hundred and thirty- nine feet, and between the LaSalle station and the north part of the county, where the railroad crosses the county line, is three hundred and seventy-one feet. Fox river shows a similar descent of the rock formation underlying the drift and Coal Measures. The difference of level between the top of the St. Peter's sandstone at the city of Ottawa and at the bend of Fox river, in section 5, township 35 north, range 5 east, is ninety-five to one hundred feet, the river bed to this point rising at a little less rate than the sandstone through which it runs. South of the Illinois river, the difference of level of several points on the Illinois Central Railroad, shows a considerable rise in the surface in that direction, but at a less rate than northward. Tonica is one hundred and forty-three feet higher than the station at LaSalle. The south line of township 32, where the railroad crosses, is one hundred and seventy-eight feet, and the Illinois Central Railroad survey shows a gradually increasing elevation in this direction, but with undulations, to a point five miles north of Bloomington, in McLean county, which is three hundred and sixty-seven feet above the station at LaSalle. The Illinois river, at LaSalle, at its lowest stage, is eighty feet below the LaSalle station, and the valley at this point is ten to twelve feet above the river at low water.

As the country on each side of this railroad is nearly level for long distances, these few elevations will represent the general descent of the surface toward the Illinois river in this county.

The surface soil of the prairie is generally a black mold, underlaid with a yellow marly-clay. Excepting the Illinois river, the streams have very little bottom land, the valleys being deep and narrow wherever they have been cut into the underlying rocks below the Drift.

The Illinois valley is from a mile to a mile and a half wide, and varies greatly in its character in different portions of the county, which is due to the different geological formations that outcrop along its course. In the eastern part of the county, and from thence westward to the vicinity of Ottawa, the surface of the valley is formed in the lower part of the Coal Measures, the soil being silicious clay, fertile and easily worked. This changes abruptly about one mile east of Ottawa, to the St. Peter's sandstone formation, with little soil covering the rock, and many loose granite boulders scattered about. The city of Ottawa is built on this sandstone. The rock is so much exposed in the valley, and is of so friable a texture, that during the prevalence of winds, fine sand is constantly blowing. A considerable portion of the valley from Ottawa to Utica is rendered of little value for cultivation by the surface exposure of this sandstone. Near to Starved Rock, the calciferous formation, underlying the St. Peter's, comes to the surface, and some portions of this is so bare of soil as to be unfit for agricultural purposes.

Passing beyond this, westward to its junction with the St. Peter's, on the west side of the axis, the dip of this and of the Trenton limestone is so abrupt as to bring the calciferous very close to the Coal Measures. Here a marked change was noticed; the harder character of the calciferous rocks had resisted the eroding action of the water in the valley better than the softer material of the Coal Measures, and the surface of the valley is mostly above the level of the freshets of the river; but, as soon as the Coal Measures are reached below Utica, the whole valley is denuded, so that it is annually overflowed by the rise of the river.

There is reason to suppose, also, that from the character of a boring put down opposite the city of LaSalle, that the present surface of the valley does not represent the extent of the erosion by the river after it reached this part of the Coal Measures. A detailed section could not be obtained, the boring having been made several years since; but from general statements, it would appear that the erosion had extended in this part of the valley near forty feet below its present surface. This would be lower than the present bed of the river. There are evidences that the bed of the river within this part of the Coal Measures has changed its course in the valley. There is at present a bayou putting up from the river, near the mouth of the canal, which has at no distant date been a river channel, and probably the main one, from which, by some obstruction above the head of the bayou, the river was directed into its present channel. From the east line of the county, there is considerable fall in the river, to where it strikes the Coal Measures, in section 24, township 33 north, range 1 east; but from this point the descent is very slight, and from thence, also, the bottom lands are very low, to the western boundary of the county, and subject to annual overflows.

*Scenery.*—The bold bluffs prevalent along the streams present at many points fine scenery, especially along the Illinois river, in the western half of the county, and along the Big Vermilion. Prominent among them is Starved Rock, near Utica, in the north-west quarter of section 22, township 33, range 2 east, rising perpendicularly from the Illinois river one hundred and twenty-six feet. Buffalo Rock is another, standing out in the valley as an island, which it has been at some former period. It is chiefly in the south part of sections 17 and 18, township 33, range 3 east, and is not as high as the former. From Starved Rock, for several miles up the river, the sandstone bluff is indented at intervals with fissures having perpendicular walls, and, in length, from a few hundred feet to half a mile, forming canyons, some of which are places of popular resort. Another one, and best known, is Deer Park, on the farm of WM. CLAYTON, Esq., on the south-west quarter of section 29, and north-west quarter of section 32, township 33, range 2. This puts out from a bend of the Big Vermilion, is about one-quarter of a mile long, and is in the form of an elongated letter "S," with high perpendicular walls, and abruptly terminating in a dome, open at the top, and about one hundred and fifty feet in diameter at the base, with a fine spring of soft water bubbling up at its base. In the wet season there is a beautiful water-fall of twenty-five feet, which enters it through a narrow chasm at the head. The hight of the dome is about seventy-five feet. This and part of the entrance is fringed at the top with pines. It is a place of almost daily resort throughout the year by visitors from this and neighboring counties.

Some bold limestone bluffs occur on the Big Vermilion, one mile south and south-west of Deer Park, and a sandstone bluff, several times recurring on the same stream, in townships 31 north, range 3 east and 32 north, ranges 2 and 3 east, form pleasant features in the scenery. From the fact that no roads cross this river, and the settlements are in the prairie, away from its banks, few seem to be aware of the character of the banks of this stream and its beauty. The bold mural cliffs of this stream, of the Illinois west of Ottawa, and the lower part of the Pequamsoggin and Little Vermilion, occurring as they do in a prairie region, form a novel contrast with the prevailing character of the county.

*Timber.*—All the streams are lined with timber on the bluffs and in their valleys; in the latter case the Illinois valley is, for the most part, to be excepted, being almost entirely open. There is a heavy growth of timber in the valley at the west side of the county, from Peru to the county line, and considerable growth at the east end for three or four miles. Along the streams entering the Illinois river, continuous bodies of timber exist; and in many places the timber is encroaching on the prairie, showing growths of from ten to twenty years. Old settlers quite uniformly speak of the timber encroaching on the prairies, which they attribute to the fires spreading less frequently from the prairie into the timber, destroying the young growth, since the country has become well settled.

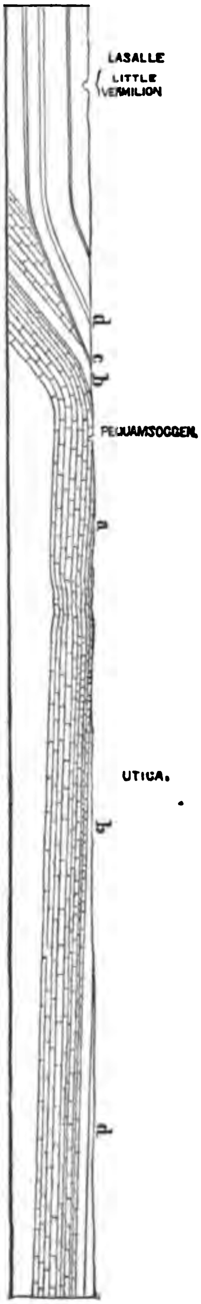
The timber is chiefly oak of several varieties, in wet places, while birch and cotton-wood were noticed on the bluffs. Crab-apples are abundant in clusters and isolated trees; wild plums, also. These seemed more abundant along the Big Vermilion than elsewhere. Along the limestone bluffs cedars were common, with arbor-vitæ; and the sandstone bluffs were often fringed with pines. The small undergrowth appeared to be mainly hazel. The sandy upper bottoms of the Big Vermilion were plentifully covered with wild gooseberries.

The wild grape, *Vitis estrialis*, was plentiful in the valleys, and to some extent appeared among the timber on the bluffs.

## *Geological Formations.*

The great feature in the geological structure of this county is the anticlinal axis, extending diagonally across it, about north thirty-three degrees west, the central line of which may be seen where the Pequamsoggin emerges from the bluffs into the Illinois Valley, on the south line of the south-west quarter of section 7, township 33, range 2 east, exposing here the upper portion of the Calciferous division of the Potsdam, which is the oldest formation that has been seen in this State, and has not been found outside of this county.

To the northward this axis is easily traced until it disappears under the Drift, on sections 22 and 23, township 34, range 1 east. Its western slope is well defined, at the junction of the Trenton limestone with the St. Peter's sandstone, on section 22, township 34, range 1 east; at the junction of the Coal Measures with the St. Peter's, on the north-west quarter of section 35, township 34, range 1 east, near the mouth of the Tomahawk; also along that stream in the section next north, at the junction of the St. Peter's with the Calciferous formation; at the railroad tunnel, on the north-east quarter of section 13, township 33, range 1 east, where the junction of the Trenton limestone with the St. Peter's is clearly seen; at Little Rock, on section 19, township 33, range 2 east, in the St. Peter's; at the entrance to Deer Park, on the north-east quarter of section 31, township 33, range 2 east; at the junction of the lowest beds of the Trenton limestone with St. Peters; and at Big Bend, in the north-west quarter of section 5, township 32, range 2 east, where the lowest beds of the Trenton are exposed.



The formations exposed in this county, below the Drift, are Coal Measures, both upper and lower; Trenton limestone, St. Peter's limestone, and the upper part of the Calciferous division of the Potsdam period.

West of the axis the Coal Measures, where resting on the Trenton at the outcrop, are inclined at an angle of about ten degrees, the dip of the Trenton being forty degrees. The Coal Measures extend over and rest unconformably on the St. Peter's also, at about the same angle. The Trenton and St. Peter's are every where conformable to, and appear to be the same with, the Calciferous.

The good exposures of Trenton and St. Peters, from Deer Park northward, on the west side of the axis, give a dip of forty degrees to the south-west. Southward from Deer Park the dip becomes less, being about six degrees at Lowell, with Coal Measures still unconformable at a less angle.

The eastern dip, near the axis, is only one or two degrees, and a couple of miles east of the axis the formations are level in that direction, or very nearly so; that is, in a line about at right angles with the axis. There is a gentle dip to the south-east.

North of the Illinois river, east of the axis, and in the Illinois bluffs on the south side, the Coal Measures resting on the St. Peter's sandstone are conformable to it. Farther south there seems to be an increasing dip in a south-east direction of the sandstone, or a less dip of the Coal Measures, and the Trenton comes in between. This may be seen in Covel creek, near its mouth.

The section annexed, shown in the margin, taken on the north side of the Illinois river, extending from LaSalle to near the east line of township 33, range 2 east, exhibits the relations of the several geological formations as they occur. a. is the Calciferous; bb., St. Peter's Sandstone; c. Trenton limestone; dd. Coal Measures.

It will be seen that the Trenton does not appear on the east side of the axis in this section, and that in place of it the Coal Measures rest conformably on the St. Peter's. East of the axis, north of the Illinois river, and for some miles south, only the lowest bed of coal occurs, excepting in that part of the county from Marseilles eastward, where the middle LaSalle bed may be found in patches.

The St. Peter's sandstone is the formation underlying the Drift over nearly the whole of the northern part of the county, and covers about one-third of its entire area; the Coal Measures occupying a similar position over nearly all the rest of the county; the Trenton and Calciferous together covering not more than one township.

At the railroad tunnel, one and a half miles east of LaSalle, the Coal Measures, Trenton limestone, St. Peter's sandstone, and the Calciferous formation may be seen exposed in place in a distance of less than one quarter of a mile. At the entrance to Deer Park this is repeated without the Calciferous, but with finer exposures of each of the other divisions.

*Drift.*—The Drift covers the entire county, except in the valleys of the larger streams. It is of variable thickness, from a few feet, on the margins of the streams, to over one hundred in the prairie, probably as high as one hundred and fifty feet.

The tributaries of Fox river do not cut through to the bottom of the Drift more than one or two miles above their mouths; and their beds, also those of Fox river, are paved with limestone boulders of Trenton, and some apparently as recent as Niagara. In Fox river they could have come long distances down the river, but in the small tributaries they must have been washed from the Drift through which they run. Above the mouth of Mission creek the quantity is much greater than below. The Little Vermilion does not cut through the Drift above section 25, township 35, range 1 east.

The tributaries of the Big Vermilion are all short, and afford very little exposure for observations, as their beds soon rise above the bottom of the Drift.

Along the crown of the great axis, from near Big Bend, in the Big Vermilion, to section 15, township 34, range 1 east, the Drift is thin, and in some places the underlying rocks are bare.

The records of many wells and some borings were obtained in the northern half of the county, and some in the south part, from which it appears that the order of stratification of the Drift is, first below the soil a yellow, marly clay, three to ten feet, usually about five feet; gravel from a few inches to five feet, and sometimes wanting; blue clay of very variable thickness, from a few feet to forty; then a gravel bed, thickness not known, as where this is found there is an invariable good supply of water. Although this seems to be the general order of deposit of the later portion of the Drift, it varies in different places, and the blue clay reaches a much greater thickness, the gravel bed being absent, and the blue clay above and below this gravel being united in one stratum. The gravel bed, however, is widely extended and generally found. Where thick, the Drift is mainly blue clay.

The supply of water for the city of Ottawa, furnished by Judge Caton's water-works, is obtained from one of those gravel beds on the bluff, one hundred and twenty-five feet above the level of the city. The water is collected to fill the pipes by simply extending a line of large drain-tiles into the gravel-bed on a level and near the bottom, the opening being made by cutting into the side from the slope of the hill. The greatest thickness of gravel found here was nine feet, and the bottom of the gravel is sixteen feet from the surface of the soil. This appears to be the upper gravel bed.

Wells sunk to this second gravel bed in the prairie are reported to be never failing, and the water flows in too fast for them to be drained in the ordinary way. The upper gravel bed is not always as reliable a source of supply, though in some instances the wells are reported as never failing in summer.

Some borings, of which the record was obtained, show the thickness of the Drift. One on the north-west quarter of the south-east quarter of section 23, township 35, range 2 east, shows the Drift to be sixty-three feet deep. This boring was commenced about twenty feet above the Tomahawk. Another, in the same township, in the north-west quarter of the north-west quarter of section 26, is as follows:

| | |
|---|---|
| Soil | 1 foot |
| Yellow clay and small stone or gravel | 15 feet |
| Blue clay | 85 feet |
| Gravel | 20 feet—103 feet, to St. Peter's sandstone. |

This boring is on an elevation from thirty-five to forty feet above the other and is the highest land in the vicinity. One in the west half of the south-west quarter of section 28, township 34, range 2 east, reaches St. Peter's sandstone in twenty feet.

A series of twelve borings, in the east half of township 31, range 3 east, lying east of the Big Vermilion, shows the Drift to be from twenty-nine to sixty-one feet; mostly from thirty to fifty feet. East of this it is probably deeper.

A boring at Minonk, just outside the southern limits of the county, went through the Drift one hundred and forty-one feet, to the Coal Measures.

From examinations made it was found that almost every where good supplies of water may be obtained by sinking wells from fifteen to forty feet. Another source of supply will be noticed under the head of artesian wells.

In the Drift is found a variety of boulders, from a few inches to several feet in diameter, and they are often found collected in quantities in the little washes adjacent to the larger streams. They consist of granite of several varieties, trap, green-stone, hornblende, and quartz. Occasionally pieces of copper have been found, from an ounce to seventy pounds in weight; and agates, quartz and jasper. Of the latter, I found a boulder fifteen inches in diameter, on top of the prairie.

## *Coal Measures.*

The Coal Measures occupy about two-thirds the area of the county underlying the Drift. West of the great axis running through the county, the Upper and Lower Coal Measures are found nearly co-extensive, with a maximum thickness of over five hundred feet; while east of it, for the most part, only the lower measures are found, and quite differently related to the older rocks below. East of the axis, wherever the base of the Coal Measures showed an exposure, they rest conformably on the St. Peter's sandstone, except at the mouth of Covel creek, where the Trenton limestone comes in between. West of the axis, wherever there are exposures showing the base of the Coal Measures, they rest unconformably, either upon the Trenton or St. Peter's, and have everywhere at the eastern outcrop along this line, an abrupt termination, forming nearly a straight line from the south of the Illinois river to section 16, township 34, range 1 east. At this point the line of boundary bends westward, running near the south-west corner of section 9, and through the south part of sections 7 and 8, to the county line. West of the axis, north of the Illinois river, and west of the Big Vermilion, south of it, there appears to be three continuous workable beds of coal, locally known as the upper, middle and lower beds; or, first, second and third beds, numbering from the top, downwards. Of these, only the lower bed is found east of the axis, and of the Big Vermilion, with the exception hereafter noticed. A fourth workable bed appears in the south part of the county. The course of the Big Vermilion appears to have been determined by the influence of the axis south of the Illinois river, in disturbing the strata of the Coal Measures. Evidences of this are apparent, extending far into Livingston county. A full section of the Coal Measures, as exposed in this county, is as follows: At the point where the top of the section was taken, the Drift covered the Coal Measures to the depth of ten feet, consisting of gravelly clay, covered with soil.

*Section.*

| | | | |
|---|---|---|---|
| 1. | Clay; blue and shaly, ochreous toward the bottom | 3 feet | |
| 2. | Coal; soft and rotten | 1 '' | |
| 3. | Clay; shaly, dark olive-colored, some ochreous; bottom 1 foot dark reddish-brown | 11 '' | |
| 4. | Limestone; argillaceous, slightly shaly | 1 '' | 8 inches |
| | Limestone; fossiliferous and argillaceous, solid | 1 '' | 6 '' |
| 5. | Shale; olive-black, bituminous, grayish | 1 '' | 8 '' |
| 6. | Marly limestone; fossiliferous | 2 '' | 8 '' |
| 7. | Coal | 1 '' | |
| 8. | Fire-clay | 0 '' | 3 '' |
| 9. | Blue shale, underlaid with brown | 15 '' | |
| | Blue shale | 2 '' | |
| | Brown shale | 8 '' | |
| 10. | Limestone; gray, seven to nine feet, (LaSalle quarries) | 9 '' | |

| | | |
|---|---|---|
| 11. Shale; blue and grayish, one to three and a half feet | 3 feet | 6 inches |
| 12. Limestone; gray, seven to twelve feet | 12 '' | |
| 13. Shale | 5 '' | |
| 14. Limestone; blue | 5 '' | |
| 15. Black slate | 7 '' | |
| 16. Coal | 0 '' | 6 inches |
| 17. Blue shale | 9 '' | 6 '' |
| 18. Blue limestone | 1 '' | 7 '' |
| 19. Blue shale | 9 '' | 3 '' |
| 20. Blue limestone | 3 '' | 5 '' |
| 21. Coal | 0 '' | 1 '' |
| 22. Fire-clay | 0 '' | 3 '' |
| 23. Blue shale | 17 '' | 1 '' |
| 24. Gray limestone | 3 '' | 6 '' |
| 25. Blue shale | 9 '' | 6 '' |
| 26. Gray limestone | 2 '' | 6 '' |
| 27. Blue shale | 12 '' | |
| 28. Blue limestone | 2 '' | |
| 29. Blue shale | 1 '' | |
| 30. Black slate | 2 '' | 6 inches |
| 31. Blue shale | 13 '' | |
| 32. Limestone; marble-streaked | 4 '' | |
| 33. Blue shale | 2 '' | 8 inches |
| 34. Blue limestone | 0 '' | 6 '' |
| 35. Brownish-red shales | 2 '' | |
| 36. Limestone | 0 '' | 4 inches |
| 37. Brownish-red and brown shale | 14 '' | 6 '' |
| 38. Sandstone | 18 '' | |
| 39. Silicious shale | 19 '' | |
| 40. Slaty shale | 11 '' | 4 inches |
| 41. Black slate | 6 '' | |
| 42. Coal, four and a half to five feet | 4 '' | 6 inches |
| 43. Fire-clay | 6 '' | |
| Dark-colored and brownish clay | 15 '' | 9 inches |
| 44. Sandstone | 34 '' | |
| 45. Black slate | 10 '' | |
| 46. Coal, three to nine feet, usually six | 6 '' | |
| 47. Fire-clay, two to four feet | 4 '' | |
| 48. Shale, silicious and argillaceous | 30 '' | |
| 49. Sandstone, fifteen feet, increasing in the south and south-west part of the county to thirty-five feet | 35 '' | |
| 50. Shales, blue-brown and black | 9 '' | |
| 51. Black slate | 2 '' | |
| 52. Black and greenish clay | 1 '' | |
| 53. Argillaceous limestone | 2 '' | 6 inches |
| 54. Shales, brown and olive, with limestone | 2 '' | |
| 55. Black argillaceous limestone | 0 '' | 4 inches |
| 56. Black slate | 2 '' | 9 '' |
| 57. Fire-clay five feet; blue clay six feet | 11 '' | |
| 58. Argillaceous limestone | 1 '' | |

| | | | | |
|---|---|---|---|---|
| 59. Blue clay shales, with bands of nodules | 22 | feet | | |
| 60. Black slate | 1 | " | 4 | inches |
| 61. Sandstone; argillaceous | 1 | " | 6 | " |
| 62. Dark clay shales, with septaria in the bottom | 8 | " | 6 | " |
| 63. Black slate and shale, with nodules, spherical and oval | 2 | " | 9 | " |
| 64. Blue clay, some shaly, fifteen to | 18 | " | | |
| 65. Coal | 4 | " | | |
| 66. Fire-clay, thin and sandy, six to ten inches | 0 | " | 10 | inches |
| 67. Sandstone, three to | 6 | " | | |
| 68. Fire-clay, light and dark-blue | 6 | " | | |
| 69. Brown shales; bottom silicious | 5 | " | | |
| 70. Black slate and shale | 6 | " | | |
| | 515 | feet | 0 | inches |

*Fossils.*—The highest fossiliferous bed found in the limestone numbered four in the section, contains *Spirifer plano-convexus.* The marly limestone, No. 6, has abundance of *Chonetes mesoloba*, *Hemipronites crenistria*, and *Myalina recurvirostris.*

No. 10, which is the LaSalle quarry rock, contains *Productus costatus* (?), *P. punctatus*, *Spirifer cameratus*, *Athyris subtilita*—all abundant—and sometimes *Pinna per-acuta*, and *Conularia.* Found a single specimen of *Macrocheilus* undetermined.

No. 45 contains *Solenomya soleniformis*, *Cox*, and an *Orthoceras*, both in pyrites. If not mistaken in the identity of the Kirkpatrick coal, referred to hereafter, the slate over which would be No. 45 of the section, there also belong to this stratum, *Solenomya radiata*, *Aviculopecten Coxanus* (?), *Cardenia fragilis*, *Petrodus occidentalis*, or dermal plate of fish, *Nautilus Illinoisensis*, *Orthoceras Rushensis*, McC., *Nucula*, *Goniatites*, and *Discena*, *Pleurotomaria*, etc.

No. 49—Sandstone.—The base of this, wherever exposed, shows more or less broken fragments of fossil coal plants undetermined, with *Sigilaria* and *Calamites* not uncommon. A single very handsome specimen of *Lepidodendron* was seen, taken from this at Marseilles. This bed of fragmentary fossil plants is the more noticeable because, in Livingston county, it is represented by a bed of coal eighteen inches thick.

No. 50.—*Rhynchonella Osagensis*, *Spirifer Kentuckensis*, *Spirifer plano-convexus*, *Orthis carbonaria*, Swallow, *Chonetes Mesoloba*, *C. Flemingii*, *Hemipronites crassus*, *Bellerophon carbonaria*, and *Pleurotomaria grayvillensis.* Fossil wood was found in the black shale of this stratum, in a shaft of the Illinois Valley Coal Company, near LaSalle.

No. 51.—Black slate has *Aviculopecten*, and small, flat, lensiform nodules, about one inch in diameter. None found containing anything organic.

No. 52—*Hemipronites crassus*, M. and H., *Chonetes Mesoloba*, *C. granulifera*, *Athyris Royissii*, *Productus longispinus.*

No. 53.—*Chonetes*, *Productus longispinus*, *Cyathoxonia Prolifera*, (?) McC., and *Crinoid stems*, very abundant.

No. 56.—Black slate, *Aviculopecten Coxanus*, and occasional large nodules of black argillaceous limestone, oval and flattened. In section 5, township 31, range 3 east, near the south line of the section, where this slate makes its last appearance in ascending the river, it has four inches of good coal underlying it, the bottom two inches of the slate being almost a cannel coal. This slate, and 51, are almost invariably found exposed together, with the associated strata between, and increasing in thickness southward.

No. 60.—This, I think, is the representative of the Trenton coal, which, with its accompanying fossils, will be noticed hereafter.

No. 62.—In the bottom of these shales are many septaria; large specimens are common, some as much as two and a half feet in diameter, form irregular spherical, the internal markings generally beautiful.

No. 63.—The nodules of this stratum are black argillaceous limestone, probably iron-stone, form mostly spherical, all sizes up to a yard in diameter, some flattened, and oval, occasionally spherical, with an equatorial band.

No. 65.—Lower LaSalle coal.—Fossils found were *Solenomya radiata*, M. and W.—*Nucula ventricosa*, Hall—in the clay over the coal. A very small specimen of *Lepidodendron* was found. Fossils are rare in this county, associated with this coal, so far as my observations extend.

In the section, from forty-six downward, there is an increase of thickness, apparently in a southern direction, in the outcrops of the Big Vermilion.

The lower LaSalle coal, No. 65 of the section, has been traced, with its associated strata, to the vicinity of Morris, in Grundy county. It is undoubtedly No. 1 B of the general section of the Coal Measure, or coal No. 2 of the Illinois river section, established in the Illinois survey, the equivalent of the fine coal at Murphysboro, in Jackson county.

The middle LaSalle coal, No. 46 in the section, is coal No. 5 of the Illinois section, according to Prof. WORTHEN'S general section of the Coal Measures in central and northern Illinois; and the upper LaSalle coal, No. 42 in the section, is No. 6 of the Illinois section.

The coal found in the south part of the county, at Streator, not shown in the section, would come in as No. 3 (?) of the Illinois section. No. 5 is considered by Prof. WORTHEN as the equivalent of the DuQuoin bed in Perry county.

The upper part of the section, down to No. 10, was taken in the excavation of the Illinois Central Railroad, adjacent to LaSalle, the only places affording good exposures. From 10 to 43, the section is chiefly from the shaft of the LaSalle Coal Mining Company, that being the best detailed record of this portion. From 43 to 70 is from shafts of the Illinois Valley Coal Company, Northern Illinois Coal and Iron Company, and Peru Coal Company, compared with outcrop observations along the Big Vermilion. The best and most carefully kept detailed record of this portion, by either of the coal companies, is that of the Illinois Valley Coal Company.

The extreme bottom of the Coal Measures was not seen. After a very careful search among the outcrops, I was unable to find anything lower than No. 68, which appears to be the usual parting between the Coal Measures and the Trenton, where they meet. Nos. 69 and 70 were obtained from the shafts.

The exposures of the Big Vermilion, from its mouth to Vermilionville, embrace the whole section, except Nos. 69 and 70, different portions being seen at intervals. Above Vermilionville, to section 8, township 31, range 3 east, the exposures along the river are from No. 48 to 62. The frequently recurring sandstone bluff, with from twelve to eighteen feet of massive sandstone, being No. 49.

In this division of the river, there is no workable coal outcropping in the banks, though coal numbered 46 in this section would generally be found not far from the left bank. In a single instance, it was found outcropping in the left bank, at low-water level, sixteen to twenty inches thick, on the north-west quarter of the south-west quarter of section 24, township 32, range 2 east.

One hundred yards down the river from this point, on the right bank, a boring made eight or ten feet above the river bed, struck the coal numbered 65, at forty feet, or about thirty feet below the bed of the river. It is here reported four and a half feet thick. This latter coal, known locally at LaSalle as the lower bed, everywhere, above Vermilionville, underlies the river. Below that point, it is mined above the river, at Lowell, and at intervals, as far down as half a mile below Deer Park. The coal mined at Big Bend is this bed. The coal exposed high up in the bluff, which can be seen to the south from the entrance to Deer Park, is No. 46 of the section, or LaSalle middle bed. It is here two feet five inches thick, and has a covering of shale.

No. 65 is concealed behind the talus below. No. 42 may also be seen in the point of the bluff formed by the first ravine, higher up the river, on the same bank. This is LaSalle upper bed. The lower bed has also been mined extensively at its outcrop at the railroad tunnel, and along the Little Vermilion; also worked at Ottawa, and along the river bluffs west of there, at Dayton, and north-east of Utica.

Above section 8, township 31, range 3 east, there is a sudden change in the appearance of the sandstone No. 49, with an increase of thickness, how much, not determined, as the base was not seen; and, presently, a coal bed appears above, known as the Kirkpatrick coal. It is first seen in the east part of section 8, extends across section 9, seen on both banks here, and reaches a short distance into the south-west corner of section 10, and abruptly terminating near where the line between sections 10 and 11 crosses the river. At this furthest point up the river, it is known as Cook's bank. It increases in thickness ascending the river, and at Cook's bank and Kirkpatrick's openings, one quarter of a mile below, it is eight feet thick, with a covering of eight feet of black slate, the lower four feet of which is highly bituminous. The slate is covered with about eight feet of gravelly clay of the Drift.

The appearance of the strata underlying this coal, where the river crosses it at the lower end, indicates a fault; but at the upper end, at Cook's bank, it is somewhat like a shelving shore at the line dividing it from the adjacent strata. As a whole, it looks like an ancient river valley filled up. I felt great uncertainty at first about the identity of this coal; but, after visiting it three times, and a very careful study of the adjacent strata, I became convinced that it is the LaSalle middle bed, No. 46 of the section. The river crosses through it for about one mile and a half. It is either an isolated outlier of this bed, or is connected with the main body in a south-west direction. I am inclined to the opinion that its appearance, as presented here, is due to two faults, letting it down from a higher level, where it would belong according to the adjacent strata on each side; the greater fault being on the down-river side.

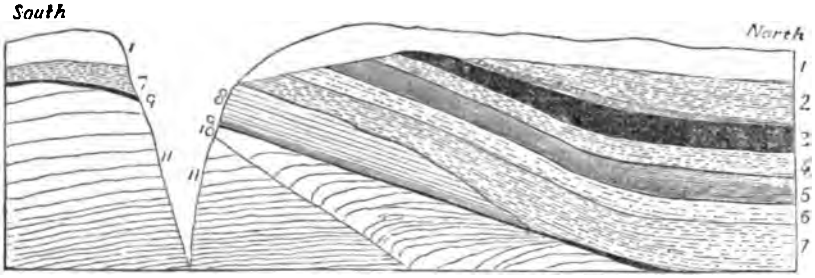
Above this point, no coal appears again in the river bluffs until opposite the mouth of Eagle creek, in the south-west corner of section 23 of the same township. Here, another bed of coal, not before seen, comes in abruptly. It is variously known as Eagle creek, Prairie creek, Hard-scrabble and Reading coal, from the several localities where heretofore mined; but will be henceforth more extensively known as the Streator coal, from the town of that name recently established by the Vermilion Coal Company, on the east bank of the river, in the south-east quarter of section 26, in the same township; which has now become the principal mining point, and from which the Coal Company has this year (1867) completed a railroad to Wenona, on the Illinois Central railroad, twelve and a half miles distant.

No boring having been made down to the coal which is below No. 65 of the section, I am unable to determine its position absolutely; the few fossils obtained being different from any obtained elsewhere, and the exposures of the strata not affording the means of tracing the connection with certainty. I feel tolerably certain, however, that its place in the section is represented by the black slate, numbered 60.

The general section was made up entirely from the shafts and exposures of the Vermilion, from its mouth to township 31, range 3 east; throughout this range everything being easily traced.

There is a fine exposure in the bluff on which the town of Streator stands, of the strata overlying this coal. It is a body of clay, slightly arenaceous and micaceous, the upper portion shaly, and is from twenty-five to thirty-five feet thick, the increase of thickness up the river, just above the town; the coal and strata above dipping to the south-east. This clay is interstratified with numerous bands of nodules, mostly of sandstone, with a band or two of small septaria, fifteen or twenty feet above the coal. The nodules change somewhat on ascending in the section, showing a little lime and iron forming iron-stones.

The dip carries the coal under the river near the south line of the town. Another exposure, half a mile below the railroad bridge, near the north line of the south-west quarter of section 26, on the left bank of the river, affords a detailed section below the coal, which is given below. From the town to this point the river runs on the outcrop, cutting off the coal from the left side. The coal crosses at the point where the section is taken. Here, the river runs due north.



The cut here given of the section will show this outcrop, which is repeated almost identical, on the right bank of the river, opposite the mouth of Eagle creek, half a mile below.

| | | |
|---|---|---|
| 1. Soil and clay | 0 feet | |
| 2. Shales | 0 '' | |
| 3. Coal; *Streator bed* | 5 '' | |
| 4. Dark shale | 1 '' | |
| 5. Black slate | 3 '' | |
| 6. Clay; olive, brown and ochreous, with bands of nodules; four inches of fire-clay at the top, and two inches of argillaceous limestone at the bottom | 2 '' | |
| 7. Shale; blue at the top, dark and almost a slate at the bottom, with bands of dark nodules, and two bands of argillaceous limestone, each four inches thick | 11 '' | 2 inches |
| 8. Sandstone; thin-bedded | 6 '' | 0 '' |
| 9. Coal; twelve to eighteen inches | 1 '' | 6 '' |
| 10. Shaly sandstone; gray | 2 '' | 6 '' |
| 11. Sandstone; mostly thin-bedded | 25 '' | |

The base of the sandstone is not seen here; but half a mile down the river, where it appears again, it rests upon shale, somewhat silicious. No. 5 has some indistinct fossil impressions—several forms of Ganoid fish-scales, impressions of fish-teeth, and *Lepidodendron*. The nodules of No. 6 contain beautifully-preserved specimens of *Leia*. They are also found in the bands of limestone of No. 7; and in the slate of No. 7 a few leaves of *Neuropteris hirsuta*. In the bottom of this were a few *Calamites*.

In digging a drain below the coal-bed, in the mine, a very fine branching specimen was found of *Lepidodendron* (?), and fine large leaves of *Neuropteris hirsuta*. These were from No. 5 of the section. Another exposure of the strata between two and eleven, one-fourth mile above the bridge, and close to town, does not afford as complete a section. The thin bed of coal is entirely wanting.

The record of a series of thirteen borings made by the Vermilion Coal Company, kindly furnished by the Secretary, Colonel RALPH PLUMB, materially assisted me in studying this coal. They show that the northern boundary of this coal runs in a north-east course from the mouth of Eagle creek, through the south-east corner of section 14 and in the north-east quarter of section 13, trending east without touching the north line of 13. Its course was not traced farther east. From my own observations I am satisfied that its extent west of the river, at its northern boundary, is confined to the little strip in the north-west quarter of section 26, and a triangular shaped piece in the north half of section 27, extending up Eagle creek, probably not more than one mile, the creek forming its northern boundary. This appears to be the north-west corner of the general area of this coal-bed. It may be on the west side of the river again, in section 35, and extend into 34, possibly. By the borings the coal was found to range from four and a half to five and a half feet in thickness. Where mined at the town it is five feet.

A noticeable feature of this bed at Streator is a thin blue clay band, one-fourth of an inch thick, running through it, about three feet from the top. Near the south-west corner of the south-east quarter of section 36, this clay band has increased to six or eight inches, while no increase was observed in a boring one-half mile north-west of this point. Near the south-east corner of the north-east quarter of section 1, township 30, range 3 east, Livingston county, this band has increased to one foot. Near the south-west corner of the south-east quarter of same section it is fifteen inches, and farther up the river, in Livingston county, its thickness is reported at two and a half feet, showing a regular increase; but no data was obtained far enough up, to show the limit of this increase, as the coal goes under the river finally a few miles above Streator, and affords no farther range for observation. Whether it is two beds of coal that come together near their northern border, or whether this is a clay parting that runs out again to the south, is yet unknown. I am disposed to regard it as two beds, and the difference in quality of the upper and lower portions favors this idea. The upper portion is much the best coal, according to common report.

The thin bed, twelve to eighteen inches thick, underlying this coal, is mined to some extent on Eagle creek, and is reported to be of finer quality than the other, though the upper three feet of the Streator coal is of superior quality. The roof of the Streator coal is clay, somewhat silicious, hard and firm, and appears to stand well.

*Area of the Coal.*—All that portion of the map showing the Coal Measures, is underlaid with the lower bed—coal No. 2, of the Illinois general section—except at some points in its northern margin, where only the underlying clay will be found; but, generally, the coal will be found not far from the margin. On account of its thinness, and the amount of covering over it, throughout a large area it has no value. This is the case with all that lying between Utica and Fox river, north of the Illinois, and the northern half or two-thirds of that lying between Fox river and the east line of the county, north of the Illinois. The exceptions to this, are where, from a good bluff exposure and a thin covering, it may be profitable to work it in a small way, by stripping the overlying strata. It is worked some in this way north-east of Utica, along the bluff of the Illinois, on top of Buffalo Rock, in the bottom adjacent to Ottawa, and near Dayton. In the north-west quarter of the south-west quarter of section 35, township 34, range 2 east, it is reported twenty-two inches in a well. Eighty rods east of the center of section 4, township 33, range 2 east, where the road crosses Clark's run, a little outcrop of light-colored clay may be seen, which is No. 68 of the LaSalle county section underlying this coal. The coal does not extend so far west at this point. In the north-west quarter of section 3, it is found eighteen to twenty-two inches thick.

By the wells, some of which were sunk to the St. Peter's sandstone, and borings put down in the south-east quarter of section 23, and north-west quarter of section 26, which reaches St. Peter's sandstone, together with the depression of the country forming the sloughs of the Tomahawk, I was able to define the Coal Measures across this township, (township 34 north, range 2 east), with tolerable certainty. Between that township and Mission creek, no positive data was obtained. The coal thins out ascending Fox river, and the last trace of anything reliable, was obtained in Mission creek. A few inches of coal in the bluff above the mouth, and some small fragments of fossil plants in sandstone, belonging to the Coal Measures, was all that was obtained here.

With this data, and what was derived from a general study of the St. Peter's sandstone immediately underlying it at all the sections north of the Illinois, east of Utica, I fixed the boundary of the Coal Measures, as indicated on the map. Some lumps of coal have been found in gravel at Milford, where Fox river enters the county; also, four inches of coal, overlaid with sand, was found in the bend of the Little Vermilion, in the south-east quarter of the north-east quarter of section 35, near Homer. Near the center of section 25, about one mile and a quarter above the last point, a similar deposit was reported as having been found. These I regard as only evidences that, prior to the Drift period the coal extended farther north than it does now.

Below Dayton, near the town, the coal is eighteen to nineteen inches thick, and has been worked some. At the mouth of Fox river, it is twenty-two inches. At Marseilles, a boring in the bed of the tail-race reached it thirty-nine feet below. Reported here to be twenty-five inches thick. No data with respect to this coal was obtained east of this point, nearer than Morris.

At Marseilles, in the river bank, near the bridge, the slate No. 51 or 56 of the LaSalle section, appears in the bank. This shows, in connection with the boring referred to, that the lower part of the Coal Measures are thinning out to the eastward. The sandstone bluff at the town is No. 49 of the section, and is here thirty to thirty-five feet thick. A fine specimen of *Calamite* was obtained from the base of this. Half a mile east of this, coal No. 46 of the section has been opened and worked. Its area was not determined, but it appears to be quite limited, like a pocket. A very fine specimen of *Lepidodendron* was shown me, taken from the sandstone at the town.

Along the south bluff of the Illinois river this lower coal ranges from twenty-four inches, at Ottawa, to two feet and six inches east of Little Rock, near the mouth of Vermilion. At Little Rock, on the west side of the axis, it is three feet and six inches. This coal becomes thicker southward. The farthest south I have knowledge of it, is the report of a boring in section 24, township 32, range 2 east, where it is four and a half feet thick. Along the Little Vermilion the outcrops of it are from two and a half feet to three and a half feet thick where worked. In a shaft of the Northern Illinois Coal and Iron Company, it is four feet thick; the same in the Peru shaft, and the Illinois Valley Coal Company's shaft, and three feet and a half in the Kenosha shaft, one mile south-east. These are the only shafts that have been sunk to it away from the outcrop. This coal, where worked, varies very little in thickness, and is quite uniform in quality. A bad feature about mining it, is the character of the roof, which is clay, and requires to be well supported; the rooms for the same reason should be worked with less width than the beds above, which have good slate roofs.

*The Streator Coal*, which is the next workable bed above this, has been before referred to, and its northern boundary, so far as known, described. In a south-west direction, it is possible this bed may extend over the greater part of townships 29 and 30, range 2 east, but nothing whatever is known about it in these townships.

*The La Salle Middle Bed*—No. 46 of the section—has a peculiarity not found in either of the others. It has a tendency to a lensiform arrangement, caused by resting upon an uneven bed. The covering, also, is uneven, apparently from the action of currents, leveling down the strata over the coal, and sometimes part of the coal itself. This feature has given rise to the opinion, among those not familiar with it, that where the coal is decreasing in thickness, it is going to run out where mined in the shafts. This is also the cause, I suppose, of its less frequent appearance than the other beds in the outcrop, and the great thickness it sometimes reaches—eight to nine feet.

To the west of the great axis, there is a gentle synclinal axis, the center of which, from observations in the bluffs of the Illinois, appears to be about at the mouth of the Little Vermilion; and it runs parallel with the great axis. This is confirmed by the lay of the coal, as found in mining from the shafts that lie near this line. The strata rise again to the westward, about fifty feet to the mile, to a point in Peru, where a gentle anticlinal gives a western dip again. The Peru shaft was struck on this anticlinal, and the Company failed to find the middle coal; but found the strata below regular to the lower coal, which they mined. On this axis, at this point, the middle coal has been cut away in the manner before described, I suppose; and it is not improbable that along this axis this coal will be as uncertain as along the upturned eastern outcrop of it. I think it can always be depended upon a little distance away from either anticlinal, toward the synclinal axis, and again to the westward of Peru. This anticlinal at Peru appears to be parallel with the main axis, about north 33 degrees west.

This bed of coal, then, may be considered as occupying all the area included in the Coal Measures west of the great axis, a little distance from its eastern margin.

The center line of the great axis, if extended southward from Deer Park, in the same course it has from thence northward in the county, would strike the south-east corner of section 32, township 31, range 3 east. This is probably not far from the fact with regard to it. The Vermilion would cross it not far from the south line of section 15, township 32, range 2 east. At Vermilionville, and below, the dip is always south-westerly; while above this line of crossing, the general dip observed was always south-easterly.

The southern dip of the formations below the Coal Measures would carry them down until they were depressed enough to admit this bed on the east side of the great axis; and I think it possible that this bed may yet be found extending over township 31 north, ranges 4 and 5 east, a large part of township 32, range 5 east, and the south-east part of township 32, range 4 east, with patches of it north-west of this area, as far as a line drawn from Marseilles to where the Vermilion crosses into township 32, range 2 east.

*The LaSalle Upper Bed*—No. 42 of the section—like the lower bed, is quite regular, varying from four and a half to five feet in thickness, as usually found. Its area is co-extensive with the Coal Measures west of the great axis, except a narrow marginal border along this line, and at its northern boundary. I do not suppose this bed will be found east of the Big Vermilion, above Lowell, unless in the south-east part of the county, occupying a smaller range than has been indicated for the middle bed. I have not learned of any boring within this range. The Peru shaft went through this bed with three feet and eight inches of coal. A boring made near the center of section 11, township 32, range 2 east, reached coal at one hundred and ninety-eight feet, reported thirty-one inches thick. Another boring near, reached coal at one hundred and sixty-two feet, seven feet thick. No sections of the strata were obtainable, and no other data given than above. This is probably No. 46 of the section, and I presume is the extension of the Kirkpatrick coal to the main body.

*Quality of the Coal.*—Of the coals mined at LaSalle and vicinity, the most popular in the market is the middle bed. The upper bed is a lighter coal, dry, free burning, with an open fire, and is a good steam coal, but consumes more rapidly than either of the others. It is a little harder to mine than the middle coal, and has some pyritous bands running through it near the top, which produce inferior coal. The mining of this bed is almost suspended.

The middle bed, from which the chief source of supply is derived, makes a denser fire; is also a good steam coal, largely used on the Illinois Central and Northwestern Railroads for locomotives, and is the popular coal for domestic use; also used in blacksmithing, by selecting it. It is mostly mined with powder, without undermining with the pick. In burning it lasts longer than the upper bed in an ordinary fire. The glass companies use it in preference to the lower coal, owing to its making a fire better suited to their work, and more economical than the lower coal, from the manner in which they burn it. It is a tolerably pure coal, has but little pyrites, and that in stratified bands, easily removed in mining. It often carries a band of cannel coal on top, from three to eighteen inches in thickness, which is of sufficiently good quality to be marketed with the rest.

The lower coal is the most highly bituminous of any of the beds, cakes in burning, and throws off a dense flaky soot, like Pittsburg coal; lasts longer in burning, and appears to be a stronger heating coal, if properly burned, than either of the others. It is an excellent coal, but has one drawback in having pyrites disseminated in very thin scales in the vertical seams, which can not be removed in mining, but, if very carefully selected, is an excellent blacksmith coal.

I think, if properly managed, it will produce a fine quality of coke, and the sulphur got rid of in the process, which will then make it suitable for iron furnaces. The large mining companies at LaSalle have not given this coal the attention it merits at their hands. By coking this coal carefully, an article of fuel for domestic use can be obtained which would supersede the great demand in Chicago for anthracite coals, and can be furnished at much less cost. People long accustomed to the cleanliness of anthracite, do not like to use bituminous coal, and hence, while they can afford it, will use the former. A superior article of coke, at a fair price, would meet the wants of the community in this respect, and gradually be accepted in place of the other. The current price of this coal in the market is fifty cents per ton more than the middle bed.

The Streator coal appears to range between the middle and lower coal in its quality, as it does in geological position; but on account of its greater freedom from sulphur, it may take a rank in the market above the lower coal, for such uses as require greater purity in this respect. It has but recently been introduced into the general market, though long known locally for its superior merit as a blacksmith's coal.

*Trenton Limestone.*—Except in two localities, the entrance to Deer Park, and on the Big Vermilion, at Lowell, the exposures of this limestone do not exceed twenty-five feet in thickness, and are of the lowest beds. These lower beds, wherever seen in the county, are quite uniform in character, dolomitic, becoming silicious at bottom, and in every exposure, but that at Lowell, the connection with the St. Peter's sandstone below may be seen. They are argillaceous and thin-bedded, those joining the St. Peter's being quite silicious. None of these lower beds are fit for good lime, but answer a good purpose for common building stone, for which they are quarried at several points.

At the railroad tunnel, a mile and a half east of LaSalle, the beds are too much covered to have value for quarrying. The dip at this point is about 40° to the south-west. From thence southward, in crossing the valley of the Illinois river, the Trenton is covered with the alluvium of the valley, and it does not appear in the bluff on the south side.

At the entrance to Deer Park, is an exposure of all the lower beds of the argillaceous qualities, gradually changing in the higher beds to a good quality of stone for burning white lime. The full thickness exposed here was not measured, and is estimated at about seventy-five feet.

The entrance to Deer Park is through the Trenton limestone, which forms portals on both sides, until it abruptly terminates against the St. Peter's sandstone, of which the walls entire of Deer Park are composed. This limestone, at this point, forms a barrier to the river, and gives it a sharp turn to the left. Continuing south-easterly, the line of upheaval strikes the Vermilion at Big Bend, where it forms the bed of the river for a quarter of a mile. There are some exposures of it in the bluff opposite, on the eastern side, where the washes have cut through to it. In the north-west quarter of section 8, township 32, range 2 east, a small exposure of it appears in the bed of the river. A little higher up the river, in the south-east quarter of section 8, the greatest exposure of it in the county begins, rising from beneath the Coal Measures in the bed of the river, and forming its bed for a mile and a half. In the river-bed, in the north-east corner of section 16, at low-water, could be seen a constant flowing of bubbles of petroleum, with ebullition of gas. This was nearly opposite Eaton's old mill. The new dam built at Lowell now keeps this covered with water, and conceals it from observation. This little exhibition of petroleum led the citizens to put down a boring for oil, on the bank adjacent, in the south-east corner of section 9, nine hundred and sixty feet deep. The section of the boring, as furnished to me, is as follows:

| | | |
|---|---|---|
| 1. After going through Drift and clay forming the base of the Coal Measures | 18 | feet. |
| 2. Limestone, Trenton | 170 | " |
| 3. Sandstone | 20 | " |
| 4. Soapstone, blue clay, probably | 10 | " |
| 5. Sandstone, St. Peter's | 600 | " |
| 6. Blue limestone | 40 | " |
| 7. White marble (?); so reported | 40 | " |
| 8. Sandstone, with very hard flint | 80 | " |

No. 5 is probably erroneous, and no doubt includes the calciferous. The intercalation of clay No. 4 in the sandstone was not seen any where else in observations of exposures. It is probable that No. 3, marked sandstone, is the silicious beds of the Trenton, at the junction with the St. Peter's, and it may be reported here at too great a thickness. No. 4, I suppose to be the clay parting between the Trenton limestone and St. Peter's. In the outcrops it was never found more than a few inches. The white marble was probably a light-colored limestone. This boring shows the Trenton limestone at this point to be one hundred and seventy or one hundred and ninety feet thick.

The only other point where this limestone was observed on the western side of the axis, is on the north-west quarter of section 22, township 34, range 1 east, on the farm of ARCHIBALD LONG. It extended a little southward on the south-west quarter. This was about twelve feet of the lowest beds, showing connection with St. Peter's, a parting of nine inches of blue clay between. It has been quarried some at this point.

By reference to the map, it will be seen that the Trenton is here expanded to the west, from a line continued parallel to the axial line, and separating the Trenton from St. Peter's. This I believe to be approximately correct, and is based upon data furnished by Mr. DIXWELL LATHROP, of LaSalle, of borings showing very nearly the outcrop of the Coal Measures.

From section 16, township 34, range 1 east, northward, the boundary between the Trenton and St. Peter's, indicated on the map as a straight line, is given as approximately correct. This seems to be quite probable, from the very regular and nearly straight line of the margin of the Coal Measures, at their junction with the St. Peter's, extending from the vicinity of Deer Park, south of the Illinois river, to section 22, township 34, range 1 east, and the further fact that this line extended would very nearly meet the outcrop of the corresponding relation of the Trenton with the St. Peter's on Rock river, near Grand DeTour; and the Trenton is conformable with the St. Peter's.

East of the anticlinal axis, the first Trenton beds to be noticed are at Homer, and vicinity, in section 35, township 35, range 1 east; also seen along the Little Vermilion, extending into section 25, where they appeared to fade out to the north-east, and disappeared near the center of the section; but, at this point, the Drift obscures everything, and the range for observation was too limited, locally, to determine this absolutely. Along the stream, it can be traced continuously from near the south line of section 35, to the middle of section 25, and to the west line of section 35, in the south-west part of the village. This rock is more extensively quarried here than at any other point in the county.

From a study of the St. Peter's sandstone as it appears on Fox river, showing an undulating surface, and the exhibitions there of these lower Trenton beds as isolated patches, I am disposed to regard this exposure at Homer as local, and left remaining after the general denudation of the Drift movement. It is not assumed that the map exhibits this patch of Trenton entire, but only so much was delineated as could be fairly determined. It is possible it extends farther in a north-west direction. There was a boring made at Mendota, which would have passed through the Trenton, if it extended that far; but no record of this was obtainable, and this evidence as to its extent in that direction is lost. Its western boundary on the Vermilion is clearly defined. From Minehart's quarry, on the west side of the river, to the one on the east side, the beds rise so rapidly, and so little appears of it on the eastern side, that its extent south-east from Homer is probably not greater than shown on the map.

The next point where it is observed is on Covel creek, near its mouth, and extending up about one and a half miles, when it disappears under the Coal Measures, with which, at this outcrop, it is nearly conformable. It is here about twenty feet thick, and corresponds in appearance with the exposures elsewhere. Its junction with the St. Peter's here is well defined. None was observed at any point farther east in the Illinois Valley. Ascending Fox river, it was first noticed in the bed of the river, a few rods above, where the north line of section 31, township 35, range 5 east, crosses the river. Only a few of the lowest beds are found here; the actual thickness could not be measured, extending below the river bed. This occurs in a depression of the St. Peter's.

Farther up the river, above Mission creek, on the north-east quarter of the north-east quarter of section 18, township 35, range 5 east, on the left bank, the lowest beds of Trenton form the bank, the top of St. Peters forming the bed of the river. On the opposite bank, a little higher up, the St. Peter's sandstone rises from the river, capped with the Trenton, lowest beds, and in less than one quarter of a mile reaches an elevation of twenty-five or thirty feet. The Trenton here is fifteen feet or more in thickness. It has been opened and quarried, and some inferior lime burned. This soon disappears, and St. Peter's forms the entire bluff, continuously on the right bank, close to the water, and on the left, some distance back from the river, to the sharp turn of the valley eastward, in section 5, same township. Soon after leaving this bend, ascending the river, the banks become low, and are no doubt formed by the top of the St. Peter's.

On the north-west quarter of section 36, township 36, range 5 east, the Trenton appears again, and from this point, ascending the river, it appears to be continuous. Brodie's quarry, north-east quarter of the north-east quarter of section 19, township 36, range 6 east, in Kendall county, on the right bank of the river, is the next fair exposure of it, and here the formation dips north sixty-five degrees east, at the rate of one foot in ten or twelve. This quarry exhibits beds higher in the Trenton than any observed below on the river, and is in heavy layers. The quarry is well opened, and fifteen feet in depth. A bed of clay in the Trenton here, four feet thick, was reported by Mr. Brodie; but no facility existed at the time for getting at it. The working of the quarry was confined to beds above this clay. This quarry is about a mile and a half up the river, beyond the LaSalle county line. A little below this quarry, on the same side of the river, the St. Peter's shows in the bluff, and a small exposure is reported on the left bank, half a mile above the quarry, and right in the direction of the dip. This shows a much greater undulation than any observed down the river. This is said to be the last exposure of sandstone, ascending the river.

From a consideration of the general aspects of the exposures of this formation, east of the great axis in this county, they appear to be local longitudinal troughs, in the St. Peter's sandstone, leveled up with the lower beds of Trenton limestone, which remained undisturbed in these depressions during the Drift movement, their extent in length not being determinable by any exposures. Other patches are probably concealed under the Drift. From the general trend of the St. Peter's and the Trenton, where exposed on Fox river and the south side of the Illinois, I think it probable that a line drawn through the center of section 9, township 32, range 2 east, and section 27, township 33, range 3 east, and continued across the Illinois river to the east side of the county, would represent very nearly the border of the underlying Trenton. North of the Illinois it would bear somewhat more northerly than the line. The beds on Covel creek appear to be a spur from the main body.

*Fossils.*—The fossils from this locality are *Lituites undatus*, *Maclurea Logani* (?) *Gonioceras anceps*, *Orthoceras fusiforme*, *Ormoceras Bachii*, *Cyrtoceras*, two species, *Endoceras annulatum*, *E. proteiforme*, *Vanuxemia*, *Ctenodouta*, *Petraia corniculum*, *Leptena sericea*, *Strophomena alternata*, and *Asaphus canalis*.

*St. Peter's Sandstone.*—This formation, where it has its full thickness, is about one hundred and fifty feet. The artesian well at Ottawa shows it one hundred and seventy-one feet. It has an extensive exposure, and occupies an area of about one-third of the county. In the Illinois valley, from the town of Utica, on the north side, and from Little Rock, one mile east of the mouth of the Big Vermilion, on the south side, to within about two miles of Ottawa, bold perpendicular bluffs of this sandstone, from forty to one hundred and twenty-five feet high, wall in this valley; and from Utica on one side, and Starved Rock on the other, the whole bed of the valley eastward, to the valley of Fox river, on the north, and a mile and a half east of Ottawa, on the south side of the valley, its bed is formed of this sandstone.

The boundary between this and the Calciferous underlying it, as it appears on the north side of the Illinois valley, east of the axis, is on the south-west quarter of section 8, township 33, range 2 east, about three-fourths of a mile west of Clark's cement mill. At this point there is two or three feet of the lower part of this sandstone capping the bluff.

Eastward, it dips seventy feet in three-quarters of a mile, and then appears to be nearly level for the next five miles, dipping a little; then an increased dip is observable, which brings the top of the formation to the bottom of the valley at Ottawa, and in the south-west quarter of section 8, township 33, range 4 east, it finally disappears under the Illinois river. South of the Illinois, it is no where seen, except at Deer Park and vicinity, and a very little exposure of it associated with the Trenton limestone, in the north-west quarter of section 8, township 32, range 2 east. Buffalo Rock, in the Illinois valley, is an isolated elevation of this rock, capped with the lower part of the Coal Measures. This body of rock has resisted the eroding action of the water, that has cut out the valley on each side of it. A noticeable feature of this formation is its tendency to form canyons wherever it appears as a high bluff and a stream of water flows over it. The most interesting of these is one near FISHBURN'S, on section 25, township 33, range 2 east, and Deer Park, before described.

This sandstone forms the bed of Fox river in this county, excepting about one mile at the eastern side, where it enters the county. On the west side of the axis the exposures of it, besides Deer Park, and in the Big Vermilion, are at the tunnel, and along the Little Vermilion and Tomahawk.

At the road-crossing of the Vermilion, on the north line of section 23, township 34, range 1 east, the lowest beds of the sandstone appear about five feet thick, and are quarried for four feet, for cellar walls. A peculiarity of the stone here, is an infinite number of small vertical holes, about the size of a knitting needle.

The bottom four feet of this rock, wherever found in the county, makes a tolerably good common building stone. All the rest lack cohesion enough for this purpose. The piers of the Chicago and Rock Island railroad bridge at the Little Vermilion, were built of this rock, quarried in the bottom near Starved Rock. In the run back of Clark's cement mill, at Utica, the connection of the St. Peter's with the Calciferous formation may be seen to the best advantage of any point observed. A thin blue clay, from one to two inches thick, separates them. This clay holds up the water which drains through the sandstone, producing fine springs at this horizon, wherever exposed, with much sandstone above. At this point the water silicifies the mosses and lichens which grow immediately below, over the face of the Calciferous rocks.

The prevailing color of this rock is a dull-buff, but great bodies of it are found, on removing the surface, perfectly white. This is selected by the glass manufacturers for their use. In texture, the rock is very uniform from top to bottom, with an even grain; and, away from old exposures, with little cohesion, except the five feet at the base. In getting it for economic purposes, it is shoveled like common sand, with the aid of a pick to loosen it.

*Calciferous.*—This has a special interest, as being the only outcrop of this formation within the State, and its area here is limited to from seven to eight square miles; besides, it contains some beds from which excellent hydraulic cement is made. Its upper surface, along the line of the axis, of which it forms the center, is quite uniform. The most northern exposure of it is on the

Little Vermilion, in the west half of section 22, and the north-west quarter of section 23, township 34, range 1 east, where it can be traced for three-quarters of a mile above the river level. The greatest thickness is fifteen feet and is the upper beds. In the bluffs on either side of the valley it is capped with St. Peter's sandstone. Where the bluff is highest the covering sandstone is only five feet thick. A little south of this it is covered only with Drift, and the Tomahawk affords some fine exposures of it for a mile. The Pequamsoggin, for one mile and a quarter, gives a continuous exposure of it, from the Illinois river bluff northward; and it is exposed in the north bluff of the Illinois river, for two miles. The best point of all for seeing the fullest section of it is in this bluff, on the south-west quarter of section 8, three-quarters of a mile west of Clark's cement mill. At this point are two slight undulations forming anticlinals. It was here the section given below was taken. It will be noticed, there are several beds of cement rock interstratified, of various thickness, and not uniform quality.

On the south side of the Illinois, it dips under the St. Peter's, the latter forming the entire bluff, but the calciferous is the surface rock of the whole width of the valley opposite to its exposure in the north bluff; and for its eastern boundary, extends from the eastern side of the town of Utica, south-east across the valley to near Starved Rock.

*Section.*

| | | | |
|---|---|---|---|
| 1. | St. Peter's sandstone; bottom 2 to 3 feet | 3 feet | |
| 2. | Silicious and cherty beds of limestone | 12 " | |
| 3. | Siliciou slimestone; oolitic | 0 " | 9 inches |
| 4. | Limestone | 1 " | 3 " |
| 5. | Sandstone; Calciferous | 0 " | 9 " |
| 6. | Limestone | 2 " | 6 " |
| 7. | Limestone, with some flints | 4 " | 6 " |
| 8. | Sandstone; Calciferous | 1 " | |
| 9. | Cement rock; good | 1 " | 8 inches |
| 10. | Sandstone | 1 " | |
| 11. | Shaly limestone and clay | 0 " | 8 inches |
| 12. | Cement rock; impure | 1 " | 10 " |
| 13. | Sandstone; Calciferous; good fire-stone, used for lining the kilns. | 3 " | |
| 14. | Cement rock; impure; breaks into small, irregular fragments; worthless | 2 " | |
| 15. | Flint | 0 " | 4 inches |
| 16. | Cement rock; impure | 0 " | 2 " |
| 17. | Limestone; arenaceous | 0 " | 10 " |
| 18. | Cement rock; impure | 2 " | 10 " |
| | Cement rock; good | 0 " | 6 " |
| 19. | Limestone; good quarry rock | 4 " | 8 " |
| 20. | Sandstone; Calciferous | 1 " | |
| 21. | Limestone; irregular masses and broken fragments | 3 " | |

| | |
|---|---|
| 22. Cement rock; upper two feet not first quality | 6 feet 9 inches |
| 23. Limestone, in beds of good quarry rock; somewhat arenaceous, and irregular quality | 4 " 6 " |
| 24. Cement rock; impure | 2 " |
| 25. Limestone | 1 " 6 inches |
| 26. Cement rock; good | 0 " 10 " |
| 27. Sandstone; Calciferous | 1 " |
| 28. Limestone | 1 " 2 inches |
| 29. Cement rock; fair quality | 1 " 6 " |
| 30. Limestone, upper part silicious | 6 " |
| 31. Cement rock; good; full thickness not ascertained, as it extends below the bed of the railroad. It contains two bands of four to six inches impure rock | 5 " |
| | 78 feet, 8 inches |

In the above section, the beds are separated by thin clay seams.

The rock quarried by Mr. CLARK is in the bottom, half a mile south-west of the railroad station. The beds are No. 22 of the above section, and are covered with two to four feet of silicious limestone, the middle, for one foot, sometimes oolitic. The appearance of most of this four feet of covering is somewhat like burr-stone. Its different appearance in the bluff is probably due to long exposure. In the quarry, the cement rock is separated from the main covering rock by a white, highly-crystalline sandstone, one half to one inch thick, very hard.

The upper portion of this cement bed contains many crystallizations of some salt of lime; the middle portion has many concretions of sulphuret of iron, small; bottom one-third appears to be free from both. The whole is thin-bedded, in irregular laminations, approaching a cherty character in form. No fossils found.

Mr. JAMES CLARK & SON, the only manufacturers of hydraulic cement here, manufacture and export sixty thousand barrels annually. It is well known in the market, from Chicago to central Iowa, and throughout this State.

## *Economic Geology.*

The first shaft for systematic coal-mining, that of the LaSalle Coal Mining Company, was finished in the spring of 1856. In the autumn of the same year, the Northern Illinois Coal and Iron Company, and the Peru Coal Mining Company, each commenced shafts, which were completed the following year. In 1865 and 1866, the Chicago Coal Company, the Illinois Valley Coal Company, and the Kenosha Coal Company, each put down a shaft.

The table below shows the location of each shaft, all in township 33, range 1 east, the coal to which it is sunk, and the depth from the top of the shaft to the top of the coal:

| Company. | Location. | Upper Coal. | Middle Coal. | Lower Coal. |
|---|---|---|---|---|
| LaSalle Coal Mining Company | S. W. ¼ Sec. 11 | 198 feet | 260 feet | |
| Northern Illinois Coal and Iron Co. | S. W. ¼ Sec. 14 | 175 feet 5 in. | 233 feet | 395 feet |
| Peru Coal Mining Company | N. W. ¼ Sec. 20 | 94 feet 5 in. | Not found | 354 feet 6 in. |
| Chicago Coal Company | N. W. ¼ Sec. 13 | 174 feet | 221 feet | |
| Illinois Valley Coal Company | S. E. ¼ Sec 23 | 224 feet 2 in. | 294 feet 3 in. | 433 feet 8 in. |
| Kenosha Coal Company | S. E. ¼ Sec. 25 | 229 feet | 283 feet | 462 feet 2 in. |

The difference in depth in these several shafts, to the same bed of coal, is due chiefly to the different points of elevation at which the respective shafts are located. The LaSalle Coal Mining Company's shaft begins at the top of the LaSalle quarry rock; the next three companies begin below it, and the last two begin above it. All these companies have the three beds of coal on their property, except, perhaps, the Peru Company. They missed the middle coal in passing the level for it in their shaft. I think quite probable, however, that it would be found by drifting from the shaft at the proper level.

The railroad and water communication give LaSalle a peculiarly advantageous position for transportation facilities, which must eventually give this point the controlling influence in the coal trade of northern Illinois; and these facilities, with the abundance of coal of qualities suited to different wants, must at the same time tend to build up a great manufacturing city here. The beginning of this movement is the permanent establishment of a large zinc smelting works and rolling mill, for reducing the ores of Wisconsin, and of glass factories.

The Vermilion Coal Company, at Streator, have already an outlet for their coal by their railroad connection with the Illinois Central railroad, at Wenona, and a prospective one by way of Ottawa and Fox river, by railroad extension in that direction.

The depth to their coal ranges from forty feet, near town, to one hundred and twenty-two feet, in an east and south-east direction. At the point of the main opening in a ravine, it is not more than twenty-five to thirty feet below the general level.

Some years ago mining was carried on for shipment to market from Marseilles, but is discontinued. The middle coal was mined. The lower coal has not been worked in this county east of the vicinity of Ottawa and Dayton, that I am aware of.

*Minerals.*—Copper has been found in the Drift, noticed under that head. Lead ore may be occasionally met with in the higher beds of the Trenton limestone, but not in quantity to be valuable; besides, these beds have a very limited range of exposure. I took out a few ounces of Galena from a vertical crevice at the dam at Lowell. The ironstones of the Coal Measures are not abundant enough to be valuable.

*Building Stone.*—The principal source of supply has been from the LaSalle quarries of the limestone, No. 10 of the general section of the county, and the lower Trenton beds. Both of these are thin-bedded, but furnish a good rock for common foundation work—some entire buildings are constructed of each of them—and the lowest bed of No. 10 furnishes a fair quality of dimension-stone, about nine inches thick.

The sandstone, No. 49 of the section, furnishes, in parts of it, a tolerably fair building stone for common cellar walls and similar uses. It is only exposed along the Big Vermilion, from Big Bend up the river, at intervals, to section 8, township 31, range 3 east, and along the Illinois bluffs, from Marseilles to Seneca. Another sandstone in the Coal Measures of the south part of the county, No. 11 of the section, near Streator, furnishes a good building stone. The upper beds of this sandstone, about two feet thick, were quarried and put into the piers of the railroad bridge at Streator.

The lowest four feet of the St. Peter's sandstone is a good building rock wherever found outcropping. It hardens by exposure. I found a house of which the cellar was constructed of this eighteen years ago. It is used also for bridge piers. Some of the strata of the Calciferous also furnish a good common building stone.

*Limestone for Lime*—Is obtained from No. 12, at LaSalle, the lime from which is shipped in considerable quantities on the railroads. It is dark-colored, and used only for common work. A fine white lime could be made from some of the Trenton beds exposed at Deer Park and Lowell—the only places in the county. The former is probably the best place for this purpose within the area comprised by the adjacent counties, and being near to cheap coal and good transportation facilities, a permanent business could be established here.

*Glass Sand.*—The St. Peter's sandstone furnishes the purest white quartz sand for glass-making, in the greatest abundance. These glass factories are in operation in LaSalle, Peru and Ottawa—one in each place—making window-glass and bottles.

*Hydraulic Cement.*—The cement rock of the Calciferous has been already noticed, in referring to that formation. The only manufactory of it is at Utica. There are two beds outcropping in the north bluff of the Illinois, west of Utica, that are of excellent quality and workable thickness; besides, thin beds of equal quality, but too thin for working profitably.

*Fire-Clay.*—The beds Nos. 43, 47 and 68, of fire-clay, are of good thickness for working. No. 43 has been found, so far as tested in shafts of one or two coal mines, to have too many small lumps of iron pyrites to be valuable. No. 47 is less reliable in its thickness, and not any better in quality. No. 68 is found tolerably free from these impurities, and has been largely used for some purposes. KIRKPATRICK'S pottery, on the Vermilion, near Lowell, works clay from this bed, obtained on the bank of the river near by. A large amount has been taken from the border of the Coal Measures, of this same bed, in sections 20 and 21, south of Utica, and transported to Joliet, for making drain-tile. The zinc manufacturers at LaSalle made thorough tests of all these beds for their purposes, and found that none would bear the high temperature sufficiently well that their retorts are subjected to in smelting ore, and they depend upon St. Louis for fire-clay.

*Peat.*—A peat-bog in the Illinois valley, west of Utica, in the north-east quarter of section 18, was found, by sounding, to be from three to ten feet in depth, and dried specimens from it appeared to be a first class article. Some discoveries east of Utica were reported, but no data obtained.

## *Miscellaneous.*

*Mineral Springs.*—A number of Springs were found impregnated with sulphur and saline matter. One in the bed of Clark's run, at the railroad crossing, a few rods west of the station at Utica, is in the top of the calciferous, is slightly magnesian and sulphurous; several near the Sulphur Spring House, above Utica, are strongly impregnated with sulphur, some magnesia, and iron; one on the south side of the river, in the north-east quarter of section 30, opposite Buffalo Rock, contains chloride of sodium, in tolerably strong solution. A salt marsh is formed by it in the swales through which it runs to the river. It rises through St. Peter's sandstone. At Lowell, one on each side in the river bed were noticed at low-water; both were from the same crevice in Trenton limestone. These are now covered by back water from the new dam. They were slightly sulphurous and magnesian.

*Gas Wells.*—A curious phenomenon, in the north-west part of the county, is exhibited by some borings in the Drift, producing gas in quantity sufficient to burn. One in the south-west quarter of the south-west quarter of section 32, township 35, range 1 east, at a depth of forty feet, after passing through blue clay, struck gravel, covered with a thin stratum of Conglomerate or cemented gravel, with a strong emission of gas, which took fire by applying a light. No water appeared, and the water that was in the gravel above ran down and disappeared in this gravel bed, which appears to be the usual second gravel of the Drift, and here lies, probably, directly on the Trenton limestone. Two other wells, bored north of Mendota, exhibited similar phenomena. In treating of the Trenton limestone, reference was made to an exhibition of petroleum, producing bubbles of gas in the river, near Vermilionville. This is probably the origin of the gas in these borings—from underlying Trenton beds; and the gas wells north of Mendota afford some evidence that the Trenton beds at Homer extend to Mendota, with increased thickness, or at least that the Trenton beds at Homer become thick enough to bring in the higher beds to the northward; and the gas may move a long distance with the water in the gravel bed. There is another possible solution: The lower LaSalle coal often emits gas in considerable quantities, when mined; and an outlying patch of this might exist in a depression of the St. Peter's sandstone. Unless well covered with clay, such a coal bed would account for the same phenomenon. My impression is, however, that the gas originates in the Trenton limestone.

*Artesian Wells.*—In all that portion of the county north of the Illinois river, east of the great axis, good water in large quantity may be obtained by artesian wells of moderate depth; and in the south part of the county, east of the axis, or of the Big Vermilion, at a gradually increasing depth in a southern direction. North of the Illinois river, water will flow over the top of a boring extending about three hundred feet below the top of the St. Peter's sandstone. A less depth, near the axis, is where the St. Peter's is thin. To this must be added the Drift, ranging from a few feet to one hundred or more. South of the river the increased depth will be the increase of thickness of the Coal Measures, and a gradually increasing thickness of the Trenton, making, together, in the south-east part of the county, perhaps two hundred to two hundred and fifty feet.

The supply of water, as indicated by borings at Ottawa and Vermilionville, is from the Calciferous beds, and a sandstone below. It is possible that in some portions of the south part of the county, water might rise to the surface from the bottom of the St. Peter's.

Brush's well, in the valley in the north part of Ottawa, after passing through the St. Peter's into the Calciferous, shows a sandstone at about three hundred feet, underlying the limestone beds, into which the boring was continued, until the well reached four hundred feet from the surface.

The record of the Ottawa well at the Court House was:

| | |
|---|---|
| St. Peter's | 171 feet. |
| Calciferous | 139 " |
| Total | 310 feet. |

No report was received of the boring below this point. Water flowed over at two hundred and eighty-six feet.

The Hitt well, in the south-west corner of the south-east quarter of the south-east quarter of section 24, township 33, range 2 east, beginning lower in the St. Peter's, struck water at two hundred and fifty-eight feet, which run over the top very strong. In this well the water contains considerable chloride of sodium, which comes in somewhere in the upper levels, as the water struck below was fresh, making it flow over less saline after it was reached.

At the Vermilionville well, water was first noticed rising soon after striking St. Peter's sandstone, and flowed over the top at a depth of about three hundred and eighty feet. This would be near the base of the St. Peter's. The flow increased for the next one hundred feet, after which no increase was noticed. This well is also somewhat saline.

The flow from all these wells is very strong. In cases where the water from these wells is saline, soft water may be obtained by tubing out the water above the lower sandstone.

In the prairie, north of the Illinois and east of the axis, a boring would need to be from four hundred to six hundred feet, according to location and depth of drift, excepting near the axis, south of the north line of township 34, where a less depth probably would answer. In the prairie, south of the river and east of the axis, from five hundred to seven hundred, or seven hundred and fifty feet, according to location, would probably be required for a strong flow of water, the deepest being in the south-east part of the county.

# PART II.

# PALÆONTOLOGY.

By F. B. MEEK and A. H. WORTHEN.

# LOWER SILURIAN SPECIES.

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## FOSSILS OF THE TRENTON GROUP.

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## RADIATA.

## ECHINODERMATA.

### *CYSTOIDEA.*

### GENUS COMAROCYSTITES, Billings, 1864.

[*κομαρον*, a strawberry; *κυστις*, a bladder.]

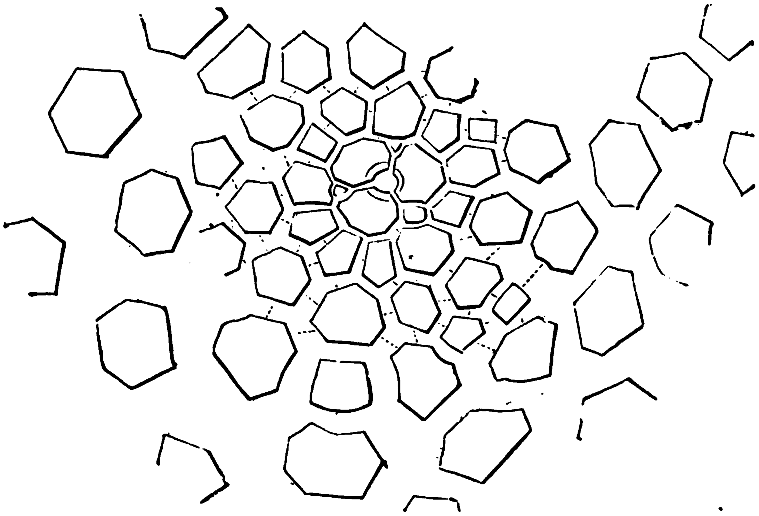
*Comarocystites*, BILLINGS, 1854. Canadian Journal, vol. ii. p. 227; Report Geol. Survey Canada, p. 288, 1856; Decade iii., Canadian Organic Remains, p. 61, 1859.

Mr. BILLINGS describes this genus as follows: "Body ovate, the smaller extremity being the base; pelvis small, of three plates, above which are from eight to eleven irregular rows of plates, mostly hexagonal; mouth near the summit provided with a valvular apparatus; arms free, grooved, and composed of a single series of joints bearing pinulæ; ambulacral orifice in the apex between the arms; column round and smooth. The plates of the only species that has been collected present, in some conditions of preservation, a peculiar vesicular structure of their exterior surfaces, while sometimes they are solid and smooth.

## COMAROCYSTITES SHUMARDI, M. & W.

Pl. 1, fig. 1 *a*, *b*.

*Comarocystites Shumardi*, MEEK and WORTHEN, Aug., 1865. Proceed. Acad. Nat. Sci., Philadelphia, p. 143.



*Comarocystites Shumardi*. Diagram showing the anatomy as far as known.

Body obovate, the summit being more broadly rounded than the lower extremity; hight about one-tenth greater than the breadth. Basal pieces wider than long, irregularly nine or ten sided, some of the sides being very short; extending out horizontally from the column, and having, at each of the sutures, a small supplementary piece wedged in between, so as sometimes to come nearly in contact with the end of the column. Succeeding ranges of plates above, five, very irregularly arranged, and differing in size and form, but increasing in diameter from below upward, mostly hexagonal or heptagonal in form; all deeply concave on the outside, with prominent sharp carinæ at the sutures; when these angular prominences are weathered or worn, slit-like pores are seen passing through the sutures, which they cross at right angles, being partly common to each of the contiguous plates.

Hight, 1.50 inch; breadth, 1.30 inch; greatest breadth of one of the plates next to upper range, 0.44 inch. Arms and openings of the summit unknown.

This species is nearly allied to *C. punctatus*, Billings, the type of the genus, from which it may be distinguished by having only five ranges of plates above the base, instead of seven or eight, as well as by the greater size of the plates near the summit, some of which measure as much as three times the diameter of those of the corresponding pieces in the Canadian species of equal size. It is true these are probably, to some degree, variable characters in this genus, but not, we should think, to the extent exhibited between the Canadian species and our specimens, in which latter they are constant. Again, where the sutures of our species have been worn so as to expose the perforations, they are seen to be less crowded, and not so numerous as in *C. punctatus*, while none of the plates, even where apparently perfectly preserved, show any traces of surface striæ.

The deep concavity of the external surface of the plates in this genus, and the sharply carinated character of the sutures between, together with the irregularity in the size, form and arrangement of the plates, give a very peculiar appearance to the fossil, that might, at a first glance, cause it to be mistaken for a coral. When only found in the condition of detached plates, they present a singular appearance, well calculated to mislead even an experienced Palæontologist who had not seen the entire fossil, or enough of the plates united, to show their true characters. The fact that they are all deeply concave, and when unworn, smooth on the outside, while the inner side is convex and strongly rayed, would naturally lead to the conclusion that the outside is the inner side, and *vice versa*. When a few of the plates are found united, however, it is at once seen that the deep concavity is on the outside, and the convexity and rays within. These rays extend one from the prominent middle of each plate to each of its sides, where they connect with those coming from the middle of the adjacent plates. When three or four of the united plates are placed with the inside upward, the spaces between the rays are seen to present the form of deep, triangular pyramidal cavities, the apex of each cavity terminating at the meeting of the corners of each three of the contiguous plates. The rays are as prominent as the convex centers of the plates, and quite narrow or linear within, but widen rapidly toward the sides of the plates. They are also each split longitudinally into parallel laminæ by a series of profound slits extending nearly to the outer surface of the plates, and it is these slits that are seen, like pores, at the prominent angular sutures, where the edges of the plates at the latter have been worn partly away. It is difficult to understand the use of these deep slits, or divisions of the internal rays, since, as noticed by Mr. Billings, they seem never to pass entirely through the plates, excepting where the prominent edges of the latter have been worn away.

Named in honor of Dr. B. F. Shumard, of St. Louis, whose labors in western Geology and Palæontology are well known.

*Locality and position.*—Cape Girardeau, Missouri. Trenton division of Lower Silurian.

### COMAROCYSTITES SHUMARDI, var. OBCONICUS, M. & W.

Pl. 1, fig. 2 *a*, *b*.

*Comarocystites Shumardi, var. obconicus*, MEEK and WORTHEN, Aug., 1865. Proceed. Acad. Nat. Sci., Philadelphia, p. 144.

A single specimen in the collection from the same locality and position as the species just described, differs in being obconical instead of obovate, its lower half tapering downward gradually to the column. Its basal plates also rise nearly vertically from the column, instead of extending out horizontally as in the typical form of *C. Shumardi.* It has a part of the column attached, showing it to be very nearly cylindrical, and composed of thin plates. In form this specimen agrees nearly with Mr. Billings' figure 2, plate 5, Decade iii., Geol. Survey of Canada, from which it differs in having only five ranges of plates above the base. It also agrees with the species we have just described, in having its plates above the middle proportionally larger, one of these plates in a specimen only 0.72 inch in hight, measuring nearly a third more in diameter than those of Mr. Billings' species, near 1.50 inches in hight.

It is quite probable this form may belong to a distinct species, but as we are not aware to what extent these curious fossils may vary, we merely call attention to it as a variety of *C. Shumardi.*

*Locality and position*, same as last.

# MOLLUSCA.

## LAMELLIBRANCHIATA.

### GENUS MODIOLOPSIS, Hall, 1847.

(Palæont. N. Y., vol. 1, p. 157.)

### MODIOLOPSIS MODIOLIFORMIS, M. & W.

Pl. 1, fig. 7 *b* and 8.

SHELL sub-rhomboidal, very oblique, between two and a half and three times as long as wide, very convex along the umbonal slopes, from the beaks to the posterior basal extremity.

Hinge rather short, ranging at an angle of about 38° to 40° above the oblique umbonal slope, and passing almost imperceptibly into the posterior dorsal outline, which slopes backward with a moderate convexity to the narrowly rounded posterior basal extremity; basal margin extending obliquely forward, with apparently a gently convex, or perhaps nearly straight outline, near the middle; .anterior side very short, and abruptly rounded. Beaks very close to the anterior end, gibbous or sub-angular, and incurved. Surface with rather obscure concentric striæ, and a few indistinct wrinkles of growth. Hinge and interior unknown.

Length, measuring obliquely from the most prominent part of the posterior basal extremity to the anterior end, about 2.10 inches; hight, at right-angles to the umbonal ridge, near 0.80 inch; convexity, as near as can be determined from an accidentally depressed specimen, about 0.80 inch.

The only specimen of this species we have seen, has suffered some distortion from nearly vertical pressure, which makes its valves appear more convex than natural, and has a somewhat crushed ventral margin, so as to make it less prominent than it must be in perfect examples. Hence, the outline of the base, of figure 8, particularly toward the front, can not be relied upon as strictly that of a perfect example of the species. It seems to have presented much the form of a true *Modiola*. As we know nothing of its hinge and interior, we only place it provisionally in the genus *Modiolopsis*, to which, however, we have not much doubt it belongs.

*Locality and position:* Trenton group, of Lower Silurian. Mineral Point, Wisconsin.

## MODIOLOPSIS ORTHONOTA, M. & W.

Pl. 1, fig. 7 *a*.

SHELL longitudinally sub-oblong, the length being about twice and a half the hight; valves quite convex, the greatest convexity being near the middle, in front of which they have an undefined concavity commencing in the umbonal region, and widening and deepening to the base, in front of the middle; cardinal margin long, very nearly straight, or but slightly arched; posterior margin obliquely sub-truncated, and sometimes very faintly sinuous above, and rather narrowly rounded near the middle; basal margin sub-parallel to the dorsal, but most convex behind the middle, in consequence of a broad sinuosity situated mainly between the middle and the front; anterior side short, rather abruptly sloping above, and narrowly rounded below. Beaks depressed upon a line with the dorsal margin, rather obtuse, and placed less than one-seventh the entire length of the valves behind the anterior extremity. Surface marked with moderately distinct concentric striæ of growth, crossed on the dorsal slope by an obscure sulcus, extending obliquely from the posterior side of the beaks to the middle of the obliquely sub-truncated upper part of the posterior margin.

Length, about 2.45 inches; hight, 0.94 inch; convexity, 0.80 inch.

In the figure of this species, the entire breadth of the anterior margin is not shown, owing to the fact that its lower edge is partly hidden in the matrix. The upper part of the posterior margin is represented as rounding too regularly into the dorsal outline, so as to completely obliterate the oblique truncation of that edge. The concentric undulations on the posterior half of the shell are also represented much too strong; while the long obscure sulcus on the dorsal slope is not represented in the figure.

This species seems to be nearly related to *M. Gesneri* of Billings (New Lower Sil., Foss., Canada, p. 43, fig. 45—1862), but it is less convex posteriorly, its greatest convexity being at about the middle instead of behind it. Its dorsal outline is also straighter, and its upper posterior edge more truncated, while Mr. Billings neither figures nor mentions the obscure sulcus seen along the dorsal slope of our specimen.

We have before us, from the Galena limestone, at Pine creek, Ogle county, Illinois, some internal casts agreeing more nearly with Mr. Billings' species.

*Locality and position:* Dunleith, Illinois; Trenton division of the Lower Silurian.

## GENUS CYPRICARDITES, Conrad, 1841.

(Ann. Report Palæontol., N. Y., p. 51.)

## GENUS OR SUBGENUS VANUXEMIA, Billings, 1858.

(Report Canadian Geological Survey for 1857, p. 186.)

### VANUXEMIA? DIXONENSIS, M. and W.

Pl. 1, fig. 5 *a*, *b*.

*Vanuxemia Dixonensis*, MEEK and WORTHEN, 1866. Proc. Chicago Acad. Sci., vol. 1, p. 16.

SHELL of medium size, thick, obliquely ovate, very gibbous; beaks tumid, very oblique, rather obtuse, somewhat incurved and terminal; anterior side a little concave just below the beaks, but without a defined lunule, thence descending with a regular curve into the rounded base; dorsal outline declining from near the beaks, with a regular oblique arch to the postero-basal margin, which rounds into the base. Hinge margin rather short, arched, somewhat gaping, and apparently provided with a narrow area, just outside of which there is an impressed line on each valve, extending from the inner posterior side of each beak backward, so as to define a lanceolate escutcheon (see fig. 5 *b*). Surface with rather strong, subimbricating marks of growth, which are distinct on the lower and posterior sides of the valves, but become obsolete over the umbonal region. Hinge and interior unknown.

Length, measuring obliquely from the beaks to the postero-basal margin, 1.23 inches; greatest breadth, at right-angles to this oblique axis, 0.90 inch. Greatest convexity, near middle of the vales, 0.95 inch.

Not having seen the hinge and interior of this shell, we can not be sure that it really belongs to the group *Vanuxemia;* but we place it provisionally in that genus, or subgenus, until its internal characters can be determined. It has the form and general external appearance of *Vanuxemia*, however, though it differs from the typical species upon which that genus was founded, in having no little protuberance in front, just below the beaks—there being at that point a lunle or excavation. It also seems to be a more gibbous and proportionally narrower species than those described from the same horizon by Mr. Billings. In some respects it agrees more nearly with *Megalomus* of Hall, and it is possible that we should call it *Megalomus Dixonensis.* These two groups, however, are thought by Mr. Billings not to be distinct.

*Locality and position:* Dixon, Illinois, from the Trenton division of the Lower Silurian.

# CEPHALOPODA.

## GENUS ORTHOCERAS, Auct.

### ORTHOCERAS (ORMOCERAS) BACKII, Stokes?

Pl. 1, fig. 4.

*Ormoceras Backii*, Stokes, 1837. Geol. Trans., 2d ser., vol. V, p. 709, referring to fig. 1, p. 80, vol. I. of same.

*Conotubularia Cuvierii*, Troost? 1838. Mem. Soc. Geol. Fr. t. III, p. 88, pl. 9 fig. 1, and pl. 10, fig. 7.

*Ormoceras tenuifilum*, Hall, 1847. Palæont. N. Y., vol. I, p. 55, pl. xv, fig. 1 *a*, *b*, *c*; pl. xvi, fig. 1 *a*, *b*, *c*, *d*, *e*, and pl. xvii, fig. 1 *a*, *b*.

ALTHOUGH this fragment is too imperfect to afford satisfactory specific characters, it is of some interest, since it presents an example of the curious mammillary appearance sometimes produced by a kind of organic deposit, often formed on the interior of these shells, the true nature of which was, we believe, first pointed out by Prof. Barrande, of Bohemia. The specimen figured consists entirely of a cast of the interior of the fossil; the shell itself, as well as its septa and siphuncle, being entirely dissolved and removed, so as to leave only the cast of the internal parts, composed of the yellow, finely-granular dolomitic matrix.

The organic deposit mentioned above, was not merely formed upon the interior of the outer walls of the shell, but also on both sides of the septa, and partly filled the large siphuncle. As the mammillary protuberances seen in the figure are merely casts, they of course represent concavities or pits in the organic incrustation of the interior. The siphuncle was large, ventral, and much expanded or swollen out between the septa. Along its middle there is a cast of the interior of a central cavity, which in the specimen figured, is exposed by the breaking away of one side of the fossil, and lies loose, though it can not be removed, owing to its enlargement within the expansions of the siphuncle farther up. These enlargements of the cast of the interior of the siphuncle, occur one within each expansion of the latter; and each sends off, all around, little horizontal branches (not well represented in the figure), evidently internal casts of canals radiating from the central cavity, and apparently passing through the walls of the siphuncle, so as to connect with the interseptal cavities. The transverse section of the shell is subelliptic.

*Locality and position:* Homer, LaSalle county, Illinois; Trenton group of the Lower Silurian.

# ARTICULATA.

## CRUSTACEA.

### GENUS LICHAS, Dalman, 1827.

(Palæad. p. 72.)

### LICHAS CUCULLUS, M. and W.

*Lichas cucullus*, MEEK and WORTHEN, Dec., 1865. Proceed. Acad. Nat. Sci., Phil., p. 266

GLABELLA very convex; middle lobe strongly elevated, or subconical, nearly three times as wide anteriorly (measuring around the front) as behind, sloping abruptly from the highest point behind the middle, with a straight or slightly concave outline, back to the neck furrow, and rounding with a regular, convex, rapidly descending curve, to the rounded front; lateral slopes declining abruptly, and separated from the lateral lobes by a linear but well defined furrow, arching forward from the neck furrow, and curving laterally on the anterior slope. Lateral lobes about half as high and three-fourths as long as the middle one, from which they slope abruptly outward; nearly as wide behind as the posterior extremity of the middle lobe at the neck furrow, but not more than half its breadth at the summit, and less than one-third its anterior breadth. Outside of these, on each side, the much smaller and lower palpebral lobes are separated from them by a linear furrow, similar and nearly parallel to those separating the lateral lobes from the central one. Neck furrow moderately well defined; neck segment very much depressed below the other parts, and sloping backward; apparently equaling about half the breadth across between the two lateral lobes behind.

Surface showing, under a magnifier, small, unequal, rather scattering pustules, with smaller intermediate granules.

Length of head, including the neck segment, 0.70 inch; do., excluding same, 0.66 inch; height, 0.60 inch; breadth, 0.96 inch; do. of middle lobe at posterior extremity, 0.28 inch; do. of same at summit, 0.41 inch; do. of same at front, 0.60 inch.

Compared with the corresponding parts of *L. Trentonensis*, this species will be at once distinguished, by its much more elevated and differently formed glabella, as well as by its less convex lateral lobes, and the presence of a defined furrow between the lateral and the palpebral lobes. Its surface is also much less strongly and distinctly pustulous. This latter character, and its proportionally narrower neck segment, as well as its more conical middle lobe, readily distinguish it from *L. Hibernicus*, of Portlock, which it more nearly resembles. It differs too distinctly from *L. Boltoni*, of the Niagara Group, to render a comparison necessary.

*Locality and position:* Alexander county, Illinois. Trenton division, Lower Silurian.

# FOSSILS OF THE GALENA BEDS.

## PROTOZOA.

### GENUS RECEPTACULITES, Defrance, 1827.

(Dict. Sci. Nat. XLV.)

### RECEPTACULITES GLOBULARIS, Hall.

Pl. 2, fig. 2 *a*, *b*.

*Receptaculites globulare*, Hall, 1861. Suppl. Wisconsin Geological Report, p. 16.

BODY obovate, or subglobose, rounded and slightly umbilicate above, and tapering to a rather broad base of attachment below. Cells arranged in the usual regularly curved lines, with transversely elongated rhomboidal apertures, which become exceedingly narrow and crowded on the sides; transverse ridges between the cells and the intervening grooves well defined, and becoming, like the cells, very closely compacted together on the sides.

This is probably the form described by Poof. Hall, under the above name, though it is proportionally longer than the specimens upon which the species was founded, which are said to be usually wider than long. We have others, however, from the same locality, agreeing more nearly with his description, and apparently not separable specifically from this.

*Locality and position:* Scales' Mound, Illinois; from the Galena division of the Lower Silurian series.

### RECEPTACULITES ————?

Pl. 2, fig. 1 *a*, *b*.

BODY depressed-subglobose; slightly umbilicate above, and apparently attached by a broad base below. Cells presenting, at the apertures, the usual transversely elongated rhombic outline, with each a small, round, contracted perforation within, and all becoming narrower and more elongated transversely, as they recede from the middle outward,* so as to be very closely compacted and extremely narrow on the sides. Transverse ridges between the cells, linear and well developed, becoming more and more closely crowded down the sides, until they appear to be in contact, and almost close the apertures of the cells below the middle.

Height, 1.16 inches; breadth, 1.68 inches.

This seems to differ from the last only in being larger and more depressed. It is probably a different species; but as several allied forms have been already named and described from these rocks, and not yet figured, we are left in doubt in regard to its specific relations, and scarcely feel warranted in identifying it with any of the described species, or in regarding it as new.

*Locality and position:* Galena division of the Lower Silurian; Galena, Illinois.

### RECEPTACULITES OWENI, Hall.

Pl. 2, fig. 3.

*Coscinopora sulcata*, Owen, 1844. Geological Report Iowa, Wisconsin and Illinois, p. 40, pl. vii., fig. 5 *a*, *b*; (not Goldfuss).

*Receptaculites Oweni*, Hall, 1861. Report Rrogress Wisconsin Geological Survey, p. 13.

BODY in the form of a broad, nearly flat, or somewhat undulated, circular disc, with a small, funnel-shaped, or umbilicoid central depression above, corresponding to the narrow, projecting base of attachment on the under side. From this point, where the disc is very thin, it increases in thickness in all directions to the periphery, which curves downward. Cell rows curving so strongly, as they radiate from the center, as to perform nearly one entire turn in a specimen eight inches in diameter, the curve always decreasing regularly from the center outward; while intercalated rows are occasionally developed between those coming from the center. Cell apertures quadrangular, or more or less rhombic at the surface, but abruptly contracting within to a smaller circular, or nearly circular, opening* into the larger cylindrical cells of the interior. Ridges between the cells moderately well developed, and running parallel to the curves of the cell rows, so as to intersect each other at more or less nearly right angles. They are sometimes, however, interrupted by obscure traces of nearly straight furrows, passing from cell to cell in direct radiating lines from the middle of the body outward.† Cells generally increasing in size from the center to the circumference of the disc, and always separated by spaces less than their own breadth, often showing traces of transverse wrinkles within, as if left by the remains of diaphragms.

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* This character is not represented in figure 1 *b*, owing to the fact that the rows of cells are not drawn as curved enough near the periphery; and hence the cells are made too large on that part of the fossil. They should have been represented as becoming more contracted outward as well as inward, from about half way between the center and the periphery of the figure. The same defect also occurs in fig. 2 *a*, though to a less extent. In figure 1 *a* and 2 *b* they are correct.

Breadth of the largest specimen in the collection (incomplete at the margins), 7.50 inches; thickness of same at the middle, 0.12 inch; do. at periphery, 0.52 inch; breadth of largest cells at the periphery, 0.13 inch.

*Locality and position:* Galena, Dixon, and other Illinois localities, in the Galena limestone (of the Lower Silurian), of which it is very characteristic. It also occurs at the same horizon in Wisconsin and Iowa.

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* Made too small in the figure.

† This character is rather too distinctly represented in the figure, on plate 2.

# RADIATA.

## ZOOPHYTA.

### ? GENUS CHÆTETES, Fischer, 1837.

(Oryct. du Gouv. Mascou, p. 159.)

### CHÆTETES PETROPOLITANUS, Pander ? (sp.)

Pl. 2, fig. 8 *a*, *b*.

*Favosites petropolitanus*, Pander, 1830. Russischen reiche, p. 105, pl. 1, fig. 6, 7, 10 and 11; probably, also, pl. 2, fig. 12 to 15; McCoy (1846), Sil. Foss. Ireland, p. 64, pl. 4, fig. 21.

*Calamopora fibrosa* (pars), Goldf., 1833. Petref. Germ., vol. I, p. 215, pl. 64, fig. 9, (not pl. 28, fig. 3).

*Favosites hemisphericus*, Kutorga, 1837. Sweit. Beitr. Zur geogn. und palæont. Dorpat's, p. 40, pl. 8, fig. 5, et pl. 9, fig. 3.

*Calamopora fibrosa*, Eichwald, 1840. Sil. Syst. in Esthand, p. 197.

*Favosites lycopodites*, Vanuxem, 1842. Report Third Geol. Dist. N. Y., p. 46, fig. 3; Mather's Report First Dist., p. 357, fig. 3.

*Chætetes petropolitanus*, Lonsdale, 1845. In Geol. Russ. vol. I, p. 596, pl. *A*, fig. 10; Keyserling (1846), Petschora-land, p. 180; d'Orb. (1845), Prodr. vol. I, p. 25; Edwards and Haime (1851), Polyp. des Terr. Palæoz., p. 268.

*Chætetes lycoperdon* (pars), Hall, 1847. Palæont. N. Y., vol. I, p. 64, pl. 23, fig. 1, and pl. 24, fig. 1 *a–h*.

*Monticulipora petropolitana*, Edw. and Haime; Brit. Foss. Corals, p. 264; Hist. Nat. Corall. t. III (1860), p. 272.

CORALLUM more or less hemispherical, the upper side being convex, and the lower flat or concave, and protected by a thin concentrically wrinkled epitheca. Calices radiating from the central region upward and outward, generally hexagonal at the surface, but apparently more rounded within, and numbering about seven to eight in the space of one-tenth of an inch; (diaphragrus unknown).

Greatest diameter of the largest specimen seen from this horizon, 2.30 inches; height, 0.90 inch.

This appears to be the form that has been by others in this country referred to the Russian species, *C. petropolitanus*, but as we have never seen any evidence of the division of the calices by the development of longitudinal partitions within, as is said by Lonsdale to be the case with *C. petripolitanus*, it may possibly be distinct. If the difference of structure said to distinguish such species as this from *C. petropolitanus* really exists, it would not only be specifically, but generically distinct, and probably fall into Lonsdale's genus, *Stenopora*, to which it has already been referred by some.

In regard to the zoological position of this genus, as well as respecting which one of several names that have been applied to it should be retained, rather widely different views have been maintained. Most authors have classed it with the *Zoophyta*; but Prof. Agassiz's investigations of the recent genus *Millepora* have led him, from analogy, to believe the genus *Chætetes* and *Favosites* belong more probably to the Hydroid group, of Acalephs, while others have supposed the former, at least, to belong to the *Polyzoa*. As we are not here making an especial investigation of any of these groups, however, we merely place this genus along with the *Zoophyta*, without thereby intending to express any opinion on these mooted points.

*Locality and position:* Galena division of the Lower Silurian, at Scales' Mound, Illinois.

# MOLLUSCA.

## BRACHIOPODA.

### GENUS LINGULA, Bruguiere, 1792.

(Encyc. Meth. 1, tab. 250.)

### LINGULA QUADRATA, Eichwald.

Pl. 2, fig. 4 *a*, *b*, *c*.

*Crania quadrata*, EICHWALD, 1829. Zool. Specialis, vol. I, p. 273, pl. 4, fig. 2.

*Lingula quadrata*, EICHWALD, 1840. Sil. Syst. in Esthland, p. 164; also Urwelt Russland (1840), heft 1, p. 15; and (1842) *ib.* heft 11, p. 58; MURCHISON DE VERN. and KEYSERLING (1845); Geol. Russ. and Ural Mts., vol. II, p. 292; HALL (1847), Paæont. N. Y., vol. I, p. 96, pl. xxx, fig. 4 *a*, *b*, *c*, and Wisconsin Report (1862), p. 46, fig. 1.

SHELL thin, attaining a large size; longitudinally semielliptic, approaching oblong, the sides being generally somewhat straightened and nearly parallel; the front rounded, or faintly subtruncate, and the posterior margins converging to the beaks at a wide angle, or more or less rounded at their points, which are obtuse; valves moderately and nearly equally convex. Surface of both valves marked by distinct concentric striæ, which along the middle of the valves are crossed by radiating lines, generally most strongly defined on exfoliated surfaces, and on the interior, particularly near the front, where they usually leave their impressions on internal casts. Internal mesial ridge of the dorsal valve generally rather stout, and extending forward from the beak beyond the middle.

Length of larger specimens, 1.50 inches; breadth about 0.90 inch.

This fine species resembles *L. Lewisii*, Sowerby, *L. tenuigranulata*, McCoy, and *L. granulata*, of Phillips; but differs from them all, in having a more elliptic and less oblong form; while its surface markings are quite distinct from those of the latter two species, both of which also exceed it in size.

*Locality and position:* Jo Daviess county; in the Galena beds of the Lower Silurian. It also occurs at the same horizon in Iowa and Wisconsin; likewise in the Trenton limestone of New York, and in the Lower Silurian rocks of Russia.

# LAMELLIBRANCHIATA.

## GENUS AMBONYCHIA, Hall, 1847.

(Palæontol. N. Y., vol 1, p. 168)

### AMBONYCHIA INTERMEDIA, M. and W.

Pl. 2, fig. 5 *a*, *b*.

SHELL (internal cast) rhombic subcordate, gibbous in the umbonal and anterior and central regions, compressed and subalate postero-dorsally; hinge line apparently a little shorter than the greatest antero-posterior diameter of the valves, and ranging at an angle of about 90° with the anterior margins of the shell; beaks prominent, gibbous pointed, and strongly incurved with a slight forward obliquity; anterior side truncated nearly vertically above, and rounding obliquely into the base, which is rather narrowly rounded; posterior side abruptly cuneate, in outline subtruncate, or moderately convex above, and rounding into the base below. Surface marked by rather fine, regular, radiating costæ, or coarse striæ, generally only obscurely defined near the free margins, to the interior of which they impart a finely crenated appearance.

Greatest diameter, measuring obliquely from the beaks to the most prominent part of the base, 0.80 inch; anterio-posterior do., 0.50 inch; convexity, 0.55 inch.

This little shell seems to be intermediate in its characters between *A. bellistriata* and *A. radiata*, having the fineness of striæ, and the convexity and incurved character of beaks, seen in the first, and the shorter and much less oblique hinge of the latter. The internal casts are somewhat excavated just under the beaks in front, and sometimes show a small protuberance almost between the beaks there, apparently like the cast of a little cavity at the termination of the hinge plate, such as are seen in some species of *Myalina*, and in *Amphicœlia*.

At first we were inclined to refer these casts to *A. bellistriata*, but their much shorter and less oblique hinge seems to be a constant character, never seen in that species.

In making comparisons with our figure 5 *b*, it should be remembered that this engraving represents the radiating striæ a little too coarse and too oblique, there being about four of them on the margin of the shell, in the space of one-tenth of an inch. The beaks are also scarcely pointed and curved forward enough in this figure, while its anterior margin is slightly too prominent in the middle, and its anterior umbonal region not convex enough from the compressed posterior dorsal alation.

*Locality and position:* Mount Carroll, Illinois; Galena division of the Lower Silurian.

## GENUS TELLINOMYA, Hall, 1847.*

(Palæontol., N. Y., vol. 1, p. 151.)

### TELLINOMYA VENTRICOSA, Hall.

Pl. 2, fig. 7 *a*, *b*, *c*.

*Tellinomya ventricosa*, HALL, 1861. Wisconsin Geological Report of Progress, p. 27; Final Report same (1862), p. 38, fig. 3.

SHELL rhombic subovate, nearly one-third longer than high, very gibbous in the umbonal region, and along the posterior umbonal slopes, with, in internal casts, an oblique concavity just before the posterior umbonal ridge; anterior side considerably wider than the other, abruptly cuneate, and in outline rounded; posterior side narrow, and apparently subangular in outline;

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* Not *Tellimya*, Brown, 1827—*Tellinomya*, Agassiz, 1846.

base very prominent anteriorly, and ascending, with a more or less distinct sinuosity near the middle, to the narrow posterior end; dorsal outline sloping nearly equally toward both extremities; beaks (in casts) rather prominent, and nearly central, or sometimes very slightly in advance of the middle. Impressions of adductor muscles very deep, the anterior ones larger than the posterior. Hinge strong, narrowing from the extremities to the beaks, toward which the two slopes converge at an angle of about seventy degrees; denticles, about eleven behind, and ten in front, to each valve, deeply interlocking, but not curved. Surface unknown.

Length of internal cast, 0.70 inch; height, 0.52 inch; convexity, 0.40 inch.

As we only know this form from imperfect internal casts, of course we can not be very positively sure our specimens belong to the same species as Prof. Hall's, though they agree so nearly that there is not much room for doubting their identity. In comparing our figures, however, it should be remembered that the anterior basal outline, in figure 7 *c* is not prominent enough, which makes the base too straight, instead of a little sinuous along the middle.

Our shell is also closely allied to the species *contractus* of Salter (Decade 1, Canadian Organic Remains, pl. viii, figs. 4 and 5), which, however, seems to be a less robust and more compressed species. Yet it is not very improbable that a comparison of a good series of specimens might show these shells all to belong to one species.

It is possible Mr. Salter's name, *Ctenodonta*, may have to be adopted for this genus, because Brown had established a recent genus of *Mollusca*, under the name *Tellimya*, in 1827; and Prof. Agassiz had corrected the orthography of this name to *Tellinomya*, in 1846. Certainly if such corrections are considered admissible at all, and the name of the recent genus is to be used as corrected, the name *Tellinomya* could be no longer retained for the fossil type.

*Locality and position:* Mount Carrol, Illinois, in the Galena beds of the Lower Silurian. The typical specimens upon which the species *T. ventricosa* was founded, were found in the Trenton limestone at Belloit and at Mineral Point, Wisconsin. It also occurs near Dubuque, Iowa, and at the Falls of St. Anthony, Minnesota. We likewise have an internal cast of apparently the same species from the Trenton limestone at Dixon, Illinois.

### TELLINOMYA ALTA, Hall.

Pl. 2, fig. 6 *a*, *b*.

*Tellinomya alta*, HALL, 1861. Geological Report of Wisconsin, p. 27.

SHELL (internal cast) small, subtrigonal, moderately convex; base regularly rounded; beaks much elevated, nearly central, arching slightly backward* (represented too straight in the figure); anterior and posterior sides sloping abruptly from the beaks at an angle of about 85°, the posterior slope (right side of fig 6 *b*) concave, and the anterior convex in outline; muscular impressions comparatively shallow, those on the posterior side circular, and the others oval. Denticles of hinge very fine. Surface unknown.

Length of internal cast, 0.60 inch; height, 0.55 inch; breadth, 0.34 inch.

This form, of which we have seen but a single internal cast, agrees very well with the description of *Tellinomya alta*, which, however, is only known to us from the description, no figures of it having yet been published. It is evidently related, as suggested by Prof. Hall, to *Ctenodonta astartiformis* of Salter, but differs in being proportionally wider, with straighter beaks. We agree with Mr. Salter, in the opinion that these short triangular forms are probably more than specifically distinct from the typical form of the genus, *Tellinomya nasuta*, though related to it in many respects.

*Locality and position:* Same as last.

## GENUS CYPRICARDITES, Conrad, 1841.

*Cypricardites*, CONRAD, 1841. Annual Report Palæontology. N. Y., p. 51.
*Cyrtodonta*, BILLINGS, 1858. Canadian Geol. Report for 1857, p. 179.
*Palæarca*, HALL, 1859. Twelfth Ann. Rep. Regents Univ. N. Y., on State Cab. N. H., p. 9.

VERY different views are entertained among Palæontologists, in regard to which of the names cited above should be retained for this genus. In first proposing the genus *Cypricardites*, Mr. Conrad included in it, provisionally, various bivalves, generally, at that time, only known from external characters, but which have since been found not to be all congeneric; while some of them have been separated under other names. From Mr. Conrad's diagnosis, how-

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*From analogy, we have to regard the side to which the beaks are turned as the posterior, in forms like this and *T. astartiformis*, Salter, as suggested by that author.

ever, and a figure prepared by him of the hinge of the species from which his diagnosis was made out, it is evident that he regarded this figured species as the illustrative example of the genus; and hence, as well as from the fact that it was the only one of the species then figured by him, we are compelled to regard it as the type of the genus, although not the first one described by him in the text. That his description of the hinge was derived from the species figured will be readily understood from his diagnosis, which reads as follows: "Equivalve, profoundly inequilateral; hinge with four or five cardinal teeth; anterior one largest and most prominent; lateral teeth short, and very remote from the cardinal teeth."

In 1858, Mr. Billings, not having seen Mr. Conrad's figure (as the plate containing it was, it appears, only distributed with a few copies of his Report), proposed the name *Cyrtodonta* for the genus, giving a good description and full illustrations of several species, in some instances showing the hinge very satisfactorily. In 1859,* Prof. Hall also proposed a new generic name, *Palæarca*, for this group, and, for a time, there was apparently some difference of opinion in regard to which of these names had priority of date; but a farther inquiry into the precise date of the actual issue of the two publications showed that Mr. Billings' name, *Cyrtodonta*, was first issued. About the same time, Prof. Hall called attention to Mr. Conrad's figure, which had long been in his possession, of the hinge of *Cypricadites*, and suggested that this name may have to take precedence for this genus, which view he has adopted in his later publications.

Although the credit of having first made known the true characters of this genus certainly belongs to Mr. Billings, it seems to us clear that the inflexible law of priority leaves no alternative but to adopt Mr. Conrad's name, since no Palæntologist who will read his description, in connection with an examination of his illustrative figure of the hinge of the type of his *Cypricardites*, need be long in doubt in regard to the particular group for which that name was really intended.

We have long suspected that Prof. Hall's proposed genus, *Aegilops*, 1850 (Third State Cab. N. H. Report Regents University N. Y., p. 171), may have been founded on a distorted internal cast of a species of this genus, though we only know it from the figures and a brief description.

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*Prof. Hall claimed, in the Twelfth Annual Report Regents University, 1859, p. 10, that his name, *Palæarca*, was proposed in 1857 (by misprint, 1847), being *in print* in his third volume, with a description and figures; but as that volume was not *published* at that time, nor for some time after, every one familiar with the rules of nomenclature must be aware that this would have no bearing whatever on the question of priority, even if *Cypricardites* had never been published.

### CYPRICARDITES ———————?

Pl. 3, fig. 9 *a*, *b*, *c*, *d*.

As we only know this form from imperfect internal casts, and several similar species have already been named, and only briefly characterized without illustration, we do not feel warranted in naming it as a new species, although it may not have been described. It seems to have been moderately convex and subcircular in form, and was characterized by an internal thickening of the anterior part of the valves. This thickening extended back from the front, nearly to the middle of the valves, where it ended abruptly, so as to leave on the internal cast a kind of blunt ridge, extending down from a little behind the beaks to below the middle of the valves, nearly at right-angles to the hinge, as seen in fig. 9*a* and *b*. The hinge margin must have also been much thickened between the beaks, which together with the other thickening mentioned, left a comparatively thin cavity in each beak, thus giving a peculiar sharp angularity to the anterior margins of internal casts of the umbones. The cast shows that there were two oblique anterior teeth between the beaks, in the left valve, and three in the right. The posterior teeth, and muscular impressions, as well as the external surface of the shell, are unknown.

*Locality and position:* Mount Carroll, Illinois; Galena division of the Lower Silurian.

### CYPRICARDITES OBLIQUUS, M. and W.

Pl. 2, fig. 9 *a*, *b*.

SHELL longitudinally sub-oblong, oblique, gibbous in the umbonal and central regions; ventral margin nearly straight along the middle, and rounding up at the extremities; anterior side very short, or nearly obsolete; dorsal outline unknown; beaks very gibbous, oblique, distinctly incurved, and nearly terminal; anterior muscular impressions very shallow, nearly circular, and placed close to the margin. Internal casts showing a few distinct, obscure, concentric undulations, and a broad obscure concavity or depression, extending from the anterior side of the beaks, obliquely backwards to the middle of the base, along the under side of a broadly rounded, undefined umbonal convexity. Surface markings unknown.

Length, 1.14 inches; height, or diameter at right-angles to the greatest length, apparently about 0.70 inch; convexity, about 0.70.

We only know this form from internal casts, none of which have the dorsal margins entire. Figure 9 *b*, therefore, does not represent the dorsal outline as in the complete shell, in which it is probably more elevated along the middle. Nor is the hinge line parallel to the dorsal outline, as seen in the figure, but ranging very obliquely across the beaks; so that if the anterior end of the specimen were raised so as to bring the hinge in a horizontal position, the longer axis of the valves would range at an angle of near 90° below it. The specimen shows nothing of the hinge excepting some indistinct marks of two or three oblique teeth, just under or nearly between the beaks. The casts of the anterior muscular scars are represented too prominent, and not more than half large enough, in fig. 9 *a*.

This species is evidently allied to *Cyrtodonta subcarinata*, Billings, (Canadian Geological Report, 1858, p. 181, fig. 5, 6 and 7), and may possibly be identical with it; but as it seems to differ materially in having its beaks more prominent, and its anterior margin below them much less so, we do not feel warranted in identifying it with that species.

*Locality and position:* Scales' Mound, Illinois; Galena beds of Lower Silurian.

# GASTEROPODA.

## GENUS BELLEROPHON, Montfort, 1808.

(Conch. Syst. I, p. 50.)

### BELLEROPHON (BUCANIA?) PLATYSTOMA, M. and W.

Pl. 8, fig. 8 *a*, *b*.

SHELL (as determined from internal casts) composed of about three volutions, which increase rather moderately in size, until near the aperture, where the last one is suddenly and very greatly expanded; inner turns rounded on the dorsum, and rounding narrowly into the umbilicus on each side; but the outer one gradually developed a mesial dorsal carina, which becomes quite distinct near the aperture; umbilicus open, and showing the inner volutions in internal casts; aperture very large, owing to the great expansion of the lip, which seems to spread out flat upon a plane. (Surface unknown).

The specimens of this species we have seen, are too imperfect to afford accurate measurement, though it was probably not less than 1.70 inches in its greatest diameter, and possibly more including the expanded lip. Some idea of the size of the aperture may be formed from the fact that some specimens show that the lip spread out farther than the remaining portion on the right side of figure 8*b*, of plate 3, and even these are broken at the margin; hence, it is evident that the aperture of specimens of the size of the one figured, must have measured not less than 1.60 inches across. The umbilicus must be, of course, small, and may possibly be closed, in specimens retaining the shell, though we suspect that it was not entirely closed.

Internal casts of this species, with the expanded portion of the lip broken away, look like some forms of *B. bilobatus*, but they have a wider umbilical, impression, while the lip in more perfect specimens is seen to be greatly more expanded. In the latter character, it must be more like *B. Canadensis*, of Billings, from which it differs entirely in being without costæ.

*Locality and position:* Galena beds of the Lower Silurian; at Galena, Illinois.

## GENUS OPHILETA, Vanuxem, 1842.

(Report III. Geol. Dist. N. Y., p. 86.)

### OPHILETA OWENANA, M. and W.

Pl. 3, fig. 6 *a*, *b*.

? *Euomphalus*, cast, OWEN, 1844. Report Geol. Explorations in Iowa, Wisconsin and Illinois, p. 80, pl. XV., fig. 8.

SHELL planorbicular, concave on both sides; the concavity above deeper than the umbilicus, which is wide and shows all the volutions. Whorls about three and a half, widest on the outer side, which is nearly vertically flattened, or a little convex, but rounding (in internal cast) to the rather narrowly rounded base; upper side very much elevated and carinate near the outer margin; thence sloping abruptly inward. Aperture rhombic ovate, its longer diameter ranging obliquely outward and upward, rather acutely angular above. Surface markings unknown.

Greatest breadth, 0.95 inch; height, 0.39 inch.

This is probably the form figured by Dr. Owen, in his report cited above, though its whorls seem to be more rounded on the under side than represented the greatest length [illegible]

[illegible]

[illegible] specimens were [illegible]

[illegible] upper arm of the [illegible]

[illegible]

This species [illegible]

[illegible]

internal cast. Aperture obliquely obovate, its longer diameter ranging downward and outward. Surface unknown.

Length or height, 0.80 inch; breadth, 1 inch.

We have preferred to give only such characters of this form as the specimens before us exhibit, because we are not quite sure they are really identical with *P. umbilicata* of Hall. If that species varies, however, to the extent indicated by Prof. Hall's figures, it would probably include our shell. We have very little doubt in regard to its identity with the specimens figured by Dr. Owen.

Those figured by Mr. Salter, being in an excellent state of preservation, and showing the external characters perfectly preserved, present quite a different aspect, in being rather more elevated, and in having all their angles much more strongly defined, and the spaces between them more distinctly flattened, or even concave. Whether or not this is entirely due to the fact that our specimens are all internal casts, is not very easy to determine, though this may be the case. In one specimen before us, apparently agreeing with that under consideration, from the Trenton group at Rockton, Illinois, the mould of the exterior, seen in the matrix, shows a distinct horizontal truncation, or flattening of the upper edge of the whorls, between the upper angle and the suture. If this is really the same species as that here described, this character would seem to indicate a specific difference from the form figured by Mr. Salter.

In regard to our figure 5 *b*, we should remark that the upper flattened slope of the body whorl, as seen in profile on the left side of the figure, is made too concave in outline, in consequence of an accidental break in the specimen. It is also worthy of note, that extremely obscure traces of *two* revolving furrows on this flattened slope of the internal cast, are incorrectly represented in the figure as *three* or *four sharp lines*. In the specimen they are not defined lines, but furrows, so faintly indicated as only to be visible by a cross light, and then indistinctly. A similar furrow is also seen on the outer vertical flattened space, just below the second angle. These furrows are probably merely accidental, and not connected with external surface markings, as no traces of them are seen on any of the other casts of the same form, from the same locality and position. Figure 5 *b* also does not represent the under side of the body volution convex enough below the third angle.

*Locality and position:* Galena division of the Lower Silurian; Mount Carroll, Illinois.

## GENUS RAPHISTOMA, Hall, 1847.

(Palæont. N. Y., vol. I, p. 28.)

### RAPHISTOMA LENTICULARIS, Conrad (sp.)

Pl. 3, fig. 7 *b*, (*a*, *c* ?)

? *Trochus lenticularis*, SOWERBY, 1839. Silurian Researches, p. 642, pl. 19, fig. 11.

*Pleurotomaria lenticularis*, CONRAD, M. S. EMMONS, 1842, Geol. Report N. Y., p. 392, fig. 2, and p. 293, fig. 2 and 3.

*Pleurotomaria lenticularis*, HALL, 1847. Palæont. N. Y., vol. I, p. 172, pl. xxxvii, fig. 6 *a*, *b*, *c*, *d;* OWEN, 1844, Report Geol. Explorations Iowa, Wisconsin and Illinois, p. 86, pl. xviii, fig. 6.

*Raphistoma lunticularis*, SALTER, 1859. Decade 1, Canadian Org. Rem., p. 12; HALL, 1862, Wisconsin Geol. Report, p. 39, fig. 4.

SHELL lenticular; breadth generally a little more than twice the height; convexity often nearly equal above and below; volutions about four and a half, flattened or slightly concave, with a moderate slope above, coincident with that of the spire, the outer or last one sharply carinate around the periphery, and convex below, the greatest convexity being near the umbilicus, into which the slope is abrupt; suture merely linear, and not very distinctly defined; umbilicus nearly as wide as the outer volution, as seen in internal casts; aperture transversely rhomboidal, the breadth being about one-fourth wider than the height. (Surface markings in our specimens not preserved).

Breadth of one of the larger specimens, 1.16 inches; height, 0.57 inch; breadth of aperture, 0.55 inch; height of same, about 0.42 inch.

The larger specimens, such as that represented by fig. 7 *b*, of pl. 3, now before us, agree well, on direct comparison, with natural casts of *R. lenticularis*, from the Trenton beds at Watertown, N. Y.* We suspect, however, that the one represented by fig. 7 *a*, *c*, may belong to a distinct species, as it has a smaller umbilicus. How far this may be due, however, to the fact that it retains the shell, while the other specimens are internal casts, we have not the means of determining.

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* Our specimens agree more nearly, in the narrowness of the whorls, with the New York examples, than that figured by Prof. Hall, in the Wisconsin Report, cited above.

We adopt the name *Raphistoma* for this type of shells provisionally, without pretending to have thoroughly studied the group with the view of determining its relations to *Scalites*, *Pleurotomaria* and the allied types, for which investigation we have not the necessary material at hand. We have the impression, however, that when the great genus, *Pleurotomaria*, embracing as it is now understood, some five or six hundred species, is thoroughly and critically studied, it will be found divisible into a number of genera, and that none of the Silurian forms *like that under consideration*, will be considered congeneric with Defrance's original type of the genus (*P. tuburculosa*) as first proposed by him.

In regard to the identity of *Raphistoma*, with *Scalites*, of Conrad, as has been suggested by several eminent authorities, although they are certainly nearly related, we would remark that we can not avoid the impression that *Scalites*, as typified by *S. angulatus*, with its distinctly canaliculated suture, singularly truncated lip, and imperforated and curved columella, ought to be regarded as constituting a distinct genus.

*Locality and position:* Galena beds of Lower Silurian; Carroll county, Illinois. *R. lenticularis* is also common in the Trenton group, New York, and at about the same horizon in this State and Wisconsin.

## GENUS MURCHISONIA, d'Archiac and d'Verneuil, 1841.

(Bull. Soc. Geol. Fr., xii, p. 154.)

### MURCHISONIA BICINCTA, Hall?

Pl. 8, fig. 4.

*Murchisonia bicincta*, HALL, 1847. Palæont. N. Y., vol. I, p. 177, pl. xxxviii, fig. 5 *a–h*;
? SALTER, 1859, Decade 1, Canadian Organic Remains, p. 19, pl. iv, fig. 5, 6, 7;
? *Murchisonia perangulata*, HALL, 1847. Palæont. N. Y., vol. I, p. 41, pl. x, fig. 4.

SHELL obliquely conical, higher than wide; spire rather short for a *Murchisonia;* volutions about six, increasing rapidly in size; in internal casts distinctly carinate around the middle of the lower turns, but the carina obsolete on the upper ones; body whorl with a second obtuse angle below the middle carina, and a slightly concave space between this and the other, while the under side, between the lower angle and the umbilicus, is only moderately convex. Surface in our specimens unknown.

Height, 1.20 inches; breadth, 1 inch; apical angle about 55°.

Our specimens of this form being merely internal casts, can not be identified with positive certainty, though they seem to agree in most respects with the above cited species. It is worthy of note, however, that they have the under side of the body volution less convex than represented in some of the figures, and the description of *M. bicincta*, given from New York specimens. To some extent, this is due to the distortion of specimens represented by our figure, but it is clearly manifest that this shell could never have had its body whorl and aperture, nearly so produced below, as represented in Mr. Salter's figure 6, cited above, which seems to represent a distinct form.

Our specimens show a small umbilical opening, but as they are internal casts, we can not doubt but this was filled by the columella. Of course they show no surface markings; nor can we see any traces on them of a third revolving angle above the most prominent one around the middle of the whorls, mentioned in the description of *M. bicincta.*

The surface of *M. bicincta* is described as being "marked by fine sharp striæ, which bend gently backwards, and are but slightly undulated in passing the upper carina [the third one not seen on our specimens], from which they turn more suddenly backwards to the mesial band, making an abrupt retral angle, and then bending forward below, pass in a vertical direction to the suture," on the upper turns. On the last volution, the striæ are said to "pass vertically to the lower slight carina, which corresponds to the suture in the other volutions, thence bending slightly backwards, curve into the umbilicus." The spiral band seems to be coincident with the middle, or most prominent angle, and is provided with two revolving marginal lines, in the New York shell.

*Locality and position :* Galena division of the Lower Silurian; Jo Daviess county, Illinois.

# CEPHALOPODA.

## GENUS ORTHOCERAS, Auct.

### ORTHOCERAS ANELLUM, Conrad.

Pl. 3, fig. 3.

*Orthoceras anellus*, CONRAD, 1843. Proceed. Acad. Nat. Sci., vol. i, p. 334.
*Orthoceras anellum*, HALL, 1847. Palæont. N. Y., vol. i, p. 202, pl. xliii, fig. 6 *a*, *b*, *c*, *d*, *e*, *f*.

SHELL slender, very gradually tapering, and a little arcuate; section nearly or quite circular; septa moderately concave, slightly oblique, and separated by spaces a little less than one-fifth the diameter of the shell; siphuncle very small, or scarcely one-ninth the diameter, situated slightly more than its own diameter on one side of the center. Surface ornamented with distinct, regular, angular annulations, narrower than the spaces between, which are regularly rounded; annulations slightly oblique, and alternating very regularly with the septa. (Surface striæ not seen in our specimen).

The best specimen of this form we have seen, is an imperfect cast, consisting of nine chambers in addition to the large outer, or body chamber; the whole measuring 2.23 inches in length. At the lower broken extremity it measures 0.50 inch in diameter, and near the middle 0.55 inch in diameter; from near which point it tapers very gradually again to a diameter of 0.50 inch near the aperture. The specimen is partly embedded in the matrix, in which an impression of the shell is continued on below, showing that the chambered part continued on at least 1.40 inches further, without materially diminishing in size, at which point the mould is broken away.

In regard to the identity of this shell with *O. anellum* of Conrad, we are by no means clearly satisfied, having no specimens of the New York form for comparison, while the figures and descriptions of that species in the Palæontology of New York * are not, as noticed by Mr. Billings, such as to afford entirely satisfactory means of comparison. Prof. Hall's figure 6 *a*, cited above, was drawn from a specimen found in the Trenton beds at Mineral Point, Wisconsin; while only the smaller specimen, represented by figure 6*d*, is from the New York locality. This latter specimen is represented with obtusely rounded annulations, and angular constrictions between, while the figure of the Mineral Point specimen represents both annulations and constrictions angular. The latter, however, is probably incorrect, as we have now before us, from Mineral Point, a specimen agreeing so exactly in all other characters with the description and figure 6*a*, that we can scarcely doubt that it belongs to the same species, while its annulations are angular, and the slightly wider constrictions between, regularly rounded. Our Mineral Point specimen does not show the siphuncle, but Prof. Hall's figure 6*b*, represents it in his specimen from that locality, nearly twice as large as in the specimen we have figured and described, and distinctly more excentric. If this is correct, our shell may be distinct from the Mineral Point form; otherwise we could scarcely doubt its identity. The question, however, whether or not the New York species, with its rounded annulations, is identical with either of those western specimens, we have not at hand the necessary materials to decide with confidence, and we therefore merely refer our shell provisionally to *O. anellum.*

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* We have no copy of Mr. Conrad's description at hand.

It might be thought that the absence of any traces of fine longitudinal striæ, both upon the internal cast, and in the mould of our figured specimen, would alone exclude it from *O. anellum*, which would certainly be the case, if we could be sure it never possessed such markings; but it is evident that the material forming the matrix, is too coarse to preserve any traces of such delicate sculpturing. This marking is well preserved, however, by the fine compact matrix of the Mineral Point specimen, which is also slightly arcuate, like that we have figured.

Our figure represents the septa and annulations too oblique; and the apparent abrupt tapering, and rounding of the lower extremity of the mould left in the matrix, is due to the oblique fracture of the rock, and not to the natural termination of the fossil.

We should mention here, that Mr. Billings has described, from the Chazy beds (Report Canadian Geol. Survey, 1859, p. 461), under the name of *O. Maro*, apparently a very similar form to that here described, though differing in some details.

*Locality and position:* Galena division of the Lower Silurian; Rockford, Illinois.

# ARTICULATA.

## CRUSTACEA.

### GENUS ILLÆNUS, Dalman, 1826.

(Palæad., p. 51.)

### ILLÆNUS TAURUS, Hall.

Pl. 8, fig. 2.

*Illænus taurus*, HALL, 1861. Wisconsin Report of Progress of the Geol. Survey, p. 27.
Compare *Illænus Americanus*, BILLINGS, 1859. Can. Nat. and Geol., vol. 4, p. 371.

BODY obovate, the widest part being across the back part of the cephalic shield. Head large, gibbous, and so strongly arched as to present nearly a semicircular curve from the anterior to the posterior margin; posterior lateral angles rounded; outline of front, as seen from above, nearly semicircular, its lower margin straight across the middle and outward to, or a little beyond, the anterior extremities of the cheeks, the lower margins of which curve down a little between this faint sinuosity and their rounded posterior extremities; posterior outline nearly straight; dorsal furrows distinct, continued between one-third and one-fourth the length of the head (measuring over the curve) forward from the posterior margin, and distant from each other more than one-third the direct breadth of the head; eyes situated near the posterior edge of the shield, and remote from the dorsal furrows, nearly on a line with the abrupt geniculations of the thoracic segments; cheeks apparently small and subovate (but their outline not clearly seen in our specimens).

Thorax scarcely half the length of the head, measuring over the curve of the latter, rather distinctly narrowing posteriorly, and composed of ten segments; its trilobation well defined, the middle lobe being broadly rounded or depressed convex, and nearly one-third wider than the lateral lobes, as seen from above; lateral lobes distinctly flattened above, from the middle one out to the geniculations of the pleuræ, where they are suddenly deflected downward almost at right angles to the upper side.

Pygidium about half as large as the cephalic shield, but much less arched, or strongly convex, rounded in outline behind; mesial lobe moderately well defined, rather convex, nearly one-half the length of the pygidium, and about one-third its breadth in front, where it projects forward with a rounded outline; anterior margin on each side of the mesial lobe transverse, and straight, out to the geniculations of the pleuræ, from which point the anterior lateral extremities are truncated nearly at right angles to the straight anterior edge.

Entire length, following the convexity of the head and pygidium, 2.95 inches; of which the head forms 1.43 inches, the thorax 0.67 inch, and the pygidium 0.85 inch; breadth of head 1.67 inches.

Although we have not had an opportunity to compare this form with authentic examples of *I. taurus*, and no figure of that species has yet been published, we can scarcely entertain a doubt in regard to the identity of our specimens with that form. At any rate, they agree as nearly with the description of *I. taurus* as different individuals of a species can be expected to do.

We should explain here, however, that the only specimens we have seen are merely internal casts, and that the one from which the figure given on plate 3 was drawn has the eyes broken off, while the breaks in the surface left by this accident were not represented by the artist. A careful examination, however, shows them to have been located near the posterior lateral angles of the cephalic shield. As represented in the figure, only about half the length of the head is seen, owing to the fact that it is bent down nearly at right angles to the longer axis of the thorax.

We are indebted to Capt. E. H. Beebe, of Galena, for the use of the best specimen of this species we have seen.

*Locality and position:* Galena division of the Lower Silurian; Galena, Illinois.

## ILLÆNUS CRASSICAUDA, Wahlenb. ? ?

Pl. 8, fig. 1 *a*, *b*.

*Entomostracites crassicauda*, WAHLENB., 1821. Nov. Act. R. Soc. Upsal, vol. VIII, p. 27, No. 2, tab. 2, figs. 5 and 6; p. 294, No. 1, tab. 8, figs. 5 and 6.

*Illænus crassicauda*, DALMAN, 1826. Vet. Acad., HANDL., p. 248, pl. v, fig. 1 *a*, *b*, *c*; HEISINGER, 1837, Leth. Suecica, p. 16, tabs. 3. and 4; PORTLOCK, 1843, Geol. Londonderry, p. 300, pl. x, fig. 3 *a*, 3 *b*, 4 and 5; HALL ? 1847, Palæont. N. Y., vol. I, p. 229, pl. lx, fig. 4 *a*, *b*, *c*, *d*.

*Illænus Trentonensis*, EMMONS ? 1842. Geol. Report, p. 300, fig. 3.

THE only specimen of this species we have seen, being much compressed and otherwise distorted, and having no other figures and descriptions of *I. crassicauda* at hand for comparison (here at Springfield), than those given by Gen. Portlock and Prof. Hall, from very imperfect specimens supposed to belong to that species, it is only provisionally that we have concluded to refer the form under consideration to *I. crassicauda*. On comparison with the last described species, it is seen to differ in having its head much less convex, and proportionally larger; while its dorsal furrows are shorter and wider apart. The mesial lobe of its thorax is also wider, and its pleuræ not so distinctly geniculated; while the anterior margin of its pygidium is much nearer straight in outline, and less distinctly trilobate. Like that species, however, it has the eyes situated very near the posterior margin of the head, and remote from the axis, and the posterior lateral angles of the cheeks rounded. Its cheeks are comparatively small, rather prominently rounded below, and pointed anteriorly. The facial sutures intersect the posterior margin of the head just behind the eyes, with a distinct outward obliquity, and the eyes are moderately large and prominent for a species of this genus. The right one is seen at the right posterior angle of the head in fig. 1 *b*.

Our specimen has the head folded upon the thorax and pygidium, and the whole rather strongly compressed together somewhat obliquely, so as to spread out the cheek on the right side (see fig. 1 *b*), while that on the opposite side is folded under. The posterior margin of the head is also folded under so as nearly to hide the short dorsal furrows, in fig. 1 *b*, as may be seen by fig. 1 *a*. The latter figure does not quite show the full size of pygidium, the margin of which is somewhat worn off in the specimen; its lateral extremities are also erroneously represented in the figure, as they are really rather distinctly truncated, at an obtuse angle with the front margin, instead of produced forward to a sharp point on each side, as seen in the figure. The thorax is slipped a little forward under the posterior edge of the cephalic shield, so as to hide, apparently, one segment. So far as can be seen, the surface seems to be without striæ or granules.

*Locality and position:* Same as last.

on its sloping upper side, the first divisions. In one ray on the anal side the second piece is pentagonal, larger than that of any of the others, and supports an arm-like range of anal pieces on its short sloping left side, above which the other pieces present the same size and form seen in the other rays.

Arms after the first division on the last radial, bifurcating again on the sixth or seventh piece, after which they are known to divide again in one arm, on the sixth piece, which is as far as our specimens show the structure.

Surface usually appearing smooth, but sometimes showing traces of scattering granules. Column comparatively large, distinctly pentagonal, and expanding upward near the base of the body, where it is composed of irregularly alternating thicker and thinner segments; central perforation small and round.

Height of body from base to the summit of first radial pieces, 0.35 inch; breadth at summit of first radials, about 0.67 inch; length of five succeeding radial pieces, 0.46 inch; breadth of do., about 0.15 inch. Breadth of column at its connection with the base, 0.32 inch.

This is perhaps the largest and most robust species of the genus known. It is composed of thick, strong plates, and the indentations or excavations at the points where the superior angle of each basal plate connects with the inferior lateral angles of the first radials, together with the more shallow depressions extending down from these points to the lower margin of the basal pieces, give a pentagonal outline to the body—the five angles being coincident with those of the column.

*Locality and position:* Cincinnati Group of the Lower Silurian series; Oswego, Kendall county, Illinois.

## HETEROCRINUS SUBCRASSUS, M. and W.

Pl. 4, fig. 5 *a*, *b*, *c*, *d*.

*Heterocrinus subcrassus*, MEEK and WORTHEN, Aug., 1865. *Ib.* p. 148.

THIS species agrees so nearly with the last in most of its characters, as to render a detailed description unnecessary. It will be readily distinguished, however, by its smaller size, as well as its less robust appearance, and the different aspect of its arms. This latter difference consists in the more slender appearance of all the divisions, and particularly in the joints of which they are composed, having their upper margins projecting beyond the base of each succeeding piece above, so as to present a kind of upward imbricating appearance and roughness, not seen in the arms of *H. crassus.*

As in the last, its rays bifurcate first on the fifth and sixth pieces, and one of them supports an arm-like series of anal pieces, on the left side of the second radial, above which it bifurcates regularly on the sixth piece. After the first regular division on the last radial piece, some of the arms are seen to divide again on the fourth, others on the fifth, and others on the sixth pieces, after which one division is known to bifurcate on the sixth piece, and still again on the thirteenth.

Breadth of body at the summit of the first radial pieces, 0.27 inch; height of do., 0.13 inch; length of rays from top of first radial pieces to the first bifurcation, 0.21 inch; entire length of arms, from first division to extremities, about 1.50 inches. Breadth of column at its connection with the base, 0.15 inch.

One of the specimens (see fig. 5 *c*) shows rising up from the summit, between the arms, the remains of a kind of trunk or proboscis similar to that of *Poteriocrinus*, *Dendrocrinus*, etc. We have not been able to make out the form of the plates composing this part, but they are seen to be strengthened by a mesial vertical ridge, and transverse sharp costæ, in pairs. The stout series of anal pieces seen extending up on the left side of this part, in fig. 5 *c*, are more like arm pieces, though differing in form from those of the arms. This series probably performed the office of a support to the proboscidiform extension of the body, with which it connects. The presence of this peculiar upward prolongation of the body, would suggest affinities of the genus to the *Poteriocrinidæ*, from which, however, these forms seem to differ in having no subradial pieces. It is possible, however, that there may be minute basal pieces within the series here regarded as such; and that the latter are really subradials. Of this, however, we have been unable to find any evidence. So far as we have been able to see, the proboscis mentioned above appears to be very similar to that of *Dendrocrinus proboscidiatus*, of Billings.

*Locality and position:* Cincinnati, Ohio; Cincinnati Group of the Lower Silurian.

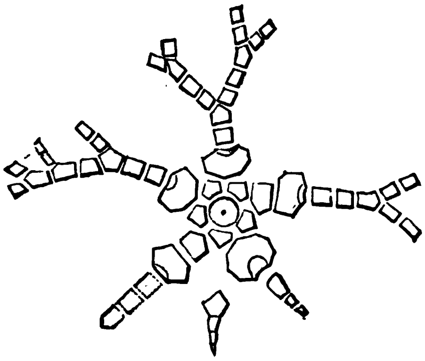
## Genus HYBOCRINUS, Billings, 1866.

### Hybocrinus? incurvus, M. and W.

### Subgenus ANOMALOCRINUS, M. and W.

Pl. 4, fig. 3 *a*, *b*.

*Heterocrinus incurvus*, Meek and Worthen, Aug., 1865. *Ib.*



*Hybocrinus? incurvus.* Diagram showing structure.

Body expanding rapidly from the base to the summit of the first and second radial pieces, where it is more than twice as wide as high; composed of the five basal, five first radial, and two second radial pieces. Basal pieces pentagonal, of moderate size, wider than long, and forming together a low, rapidly-expanding, pentagonal cup. First radial pieces in three of the rays from three to five times as large as the basal pieces, wider than long, two hexagonal and one heptagonal—all with their superior lateral angles strongly incurved between the arms, and each with a small protuberant, rounded facet above, for the reception of the small succeeding radials. In the remaining two rays, the first pieces are smaller and lower than those of the others, and each pentagonal in form, with the upper side horizontally truncated in its entire breadth, for the reception of a larger second radial, which in these two rays agrees in size and form, as well as in being included as a part of the walls of the body, with the large first pieces of the other rays. Succeeding radials not more than one-third as wide as those included in the walls of the cup, and forming small, rounded, widely separated free arms, consisting of one to three quadrangular and one pentagonal pieces to each ray. Arms above the first bifurcation on the second or third pentagonal free radial, in two of the rays seen, bifurcating again on the third piece, and, in one instance, sending off nearly at right-angles from the second piece after the first division, a strong tentacle, or small lateral branch.

First anal piece pentagonal, longer than wide, and resting between the left sloping side of a large second primary radial, and the right sloping side of a first primary radial, with rather less than half its length projecting above the former, and without extending down so as to bring its base in contact with any of the other plates below. In the individual examined, this piece is strongly incurved, and supports on its inner truncated end an oblong, narrow second anal, which in its turn supports a smaller third piece, all of which are arranged in a right line, and probably form one side of the proboscis.

Surface smooth or only with traces of fine granules. Sutures a little concave. Column comparatively strong and rounded near the base, where it is composed of short joints, and marked with obscure, regular longitudinal striæ.

Height of body on the anal side, 0.28 inch; do. on the opposite side, 0.22 inch; greatest breadth above (allowing for a slight accidental compression), about 0.38 inch; breadth of free arms at their connection with the body, 0.08 inch; breadth of column at its connection with the base, 0.16 inch.

This species presents points of analogy both to *Heterocrinus*, Hall, and *Hybocrinus*, Billings, and yet seems to differ from both to such an extent, that if we could be sure some of its peculiarities are not abnormal in our specimen, we would be inclined to view it as the type of a new genus. As we have seen but the one specimen, however, which is not complete in all its parts, we have concluded to place it, for the present at least, as the type of a subgenus under *Hybocrinus*. It differs from the typical species of *Heterocrinus* in having the column round instead of pentagonal, and in having only the first primary radial pieces in three of the rays, and two in each of the others, included as a part of the walls of the body; while its succeeding primary radials are very narrow, and form small, rounded, distantly separated arms, instead of being nearly as wide as those soldered in the walls of the cup. Another peculiarity is the strongly incurved superior lateral angles of the large radial pieces around the margin of the cup, between the arms, and the absence of the prolongation of the body in the form of a proboscis above.

In the rather unsymmetrical form of the body, the slender proportions of the free arms, and its general aspect, it agrees with *Hybocrinus*, from which it differs in having but one anal piece connected with the walls of the cup, and in having two of the rays and two of the primary pieces included in the wall, while its free arms bifurcate twice or oftener, instead of being simple from their origin. The latter, however, is only a specific character.

For this interesting specimen we are indebted to Mr. David H. Shæffer, of Cincinnati, Ohio.

*Locality and position:* Same as last.

## GENUS POROCRINUS, Billings, 1856.

*Porocrinus*, BILLINGS. Report Geol. Survey of Canada, 1856, p. 279; Canadian Org. Rem., 1859, Decade IV., p. 33.

*Generic formula.*—
Basal plates, 5.
Subradials, 5.
Radials, 1+5.
Proper interradials, 0.
Anals, 2.

Mr. BILLINGS' description of this genus reads as follows: "Cup conical; basal plates five, pentagonal; subradials five, three hexagonal and two heptagonal; primary radials five; one large azygos interradial supported on the truncated summit of the anterior subradial, and one small one situated over the suture between the anterior subradials, and having above it on one side the large azygos, and on the other the left anterior primary radial; several small pectinated rhombs, similar to those of the *Cystoidea*."

As remarked by Mr. Billings, this genus has the structure, so far as the form and arrangement of the plates forming the base and lateral walls of the cup are concerned, of *Poteriocrinus;* from which it differs in the important character of having pectinated openings analogous to those of the *Cystoidea*. It also differs from *Poteriocrinus* in wanting the extension of the body above the arm bases; while the openings of its vault are also different from those of *Cyathocrinus*.

Our specimens of the following described species also appear to show that this interesting type probably presented another character in common with the *Cystoidea*—that is, the possession of several rounded and non-pectinated openings. Of these openings there are apparently three, one on the anal side, and two on the anterior side.* They are all nearly on the same horizon as the bases of the free arms, though the anal opening is a little lower than the other two.

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* It is possible that some of these supposed openings, however, may be pectinated apertures, but they look like simple openings.

So it would seem this genus presents, as it were, a combination of the characters of the typical *Crinoidea* and *Cystoidea*. With the regularity of structure and arrangement of parts of a true Crinoid, it has the pectinated and other openings of a Cystidean. It differs, however, from the *Cystoidea*, in having the pectinated openings located at the junction of the *corners* of the plates, instead of *passing through them near one of the sides*, while the little bars protecting these openings are arranged obliquely, instead of at right angles to the margins of the plates, as in the *Cystoidea*.

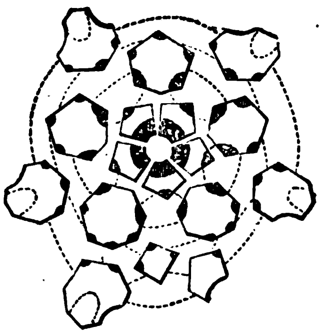
Our species also shows that the conical form of the cup is not a generic character.

## POROCRINUS CRASSUS. M. and W.

Pl. 4, fig. 2 *a*, *b*.

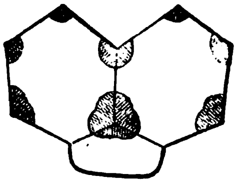
*Porocrinus crassus*, MEEK and WORTHEN, August, 1865. Proceed. Acad. Nat; Sci., Philad., p. 115.

Fig. A.



*Porocrinus crassus.*
Diagram showing structure of the body.

Fig. B.



One of the basal pieces and two of the subradials, enlarged, as seen in a side view, to show more clearly the pectinated openings.

BODY subovoid or a little higher than wide. Base depressed, rather widely truncated below, pentagonal in outline, two and a half to three times as wide as high, with a comparatively large pentagonal central perforation; basal pieces wider than long, pentagonal in outline. Subradial pieces twice to three times as large as the basal, about as wide as high, three hexagonal, and two on the anal side heptagonal. First radial pieces of about the same size as the subradials, apparently all irregularly heptagonal, each with, near its upper extremity, a small outward-sloping subcordate, or oval, flattened surface, for the articulation of the second (first free) radial piece; four of them with each one, and the fifth with two, of the superior lateral margins deeply sinuous and forming in part the margins of the large rounded openings of the summit. Anal pieces two; the first smaller than the other, quadrangular in form, resting between the superior sloping sides of two of the subradials, and supporting, on its right upper sloping edge, one side of one of the first radials, and on its left one of the oblique sides of the second anal piece. Second anal oblique, wider (obliquely) than its diameter in the direction of its vertical axis, irregularly pentagonal, resting with its base upon the upper truncated side of one of the subradials, and its left side against one of the first radials; while its upper right margin connects with another, and its sinuous oblique superior side forms the under margin of the anal opening. Pectinated areas situated in deep excavations, those at the angles of the basal and subradial pieces largest, and obscurely trilobate; the smaller ones at the angles above oval or subcircular. Surface ornamented with strong radiating costæ, extending from the center to each of the sides of the plates, and all widening from the center outwards. (The latter character and the furrowing of the sutures are not well represented in the figures.) Sutures distinctly furrowed, even on the truncated under side of the base.

Length, 0.72 inch; breadth, about 0.66 inch.

This species will be at once distinguished from *P. conicus*, of Billings, the typical species of the genus, by its oval instead of obconic form (being widest a little below the arms, and rounded in above) and the strong radiating costæ of its plates. We know of no other form with which it need be compared.

Like the typical species, its free arms commenced with the second radial, and were evidently slender and nearly cylindrical, or a little compressed laterally, and provided with a very small furrow above. We have not seen the column, but it appears to have been large at its connection with the base, and probably pentagonal.

Nor have we been able to see the structure of the small crown occupying the

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] above. [illegible] sides [illegible] the [illegible] surrounding [illegible] the [illegible] from the [illegible] interior [illegible] ascending [illegible] arrangement of [illegible] a series of [illegible] of [illegible] the [illegible] of [illegible]

[illegible]

the middle of the subradials, so as to present, as seen under a good magnifier, a finely substriated appearance.

Column rounded, and expanding rapidly upwards near the base, where it is composed of very thin segments with minutely crenated edges; farther down the segments are proportionally thicker and more coarsely crenate.

Length of body, 0.43 inch; breadth, at the middle of the subradials, 0.40 inch. Breadth of column at its connection with the base, 0.15 inch; do. 0.72 inch below, 0.05 inch.

This species will be readily distinguished from *P. conicus*, of Billings, by its broader, more ovoid, and more angular form, owing to the much greater prominence of its subradial pieces, and particularly by the well-defined ridges radiating from the center of the plates. In the latter character it approaches more nearly the last described species, *P. crassus*, from which it differs in a marked degree, in having its under side, below the middle of the subradial pieces, greatly more tapering, and the base much smaller, and not wider than the head of the column, as well as proportionally higher. It also differs in having its greatest breadth at the middle of the subradial pieces, which are much more prominent; while its pectinated openings are not sunken, nor its sutures furrowed, as in the last.

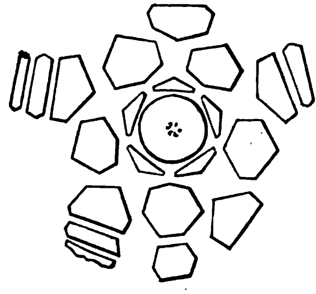
*Locality and position:* Trenton division of the Lower Silurian, at Dixon, Illinois.

## GENUS DENDROCRINUS, Hall, 1852.

(Palæontol. N. Y., vol. II, p. 193.)

### DENDROCRINUS OSWEGOENSIS, M. and W.

Pl. 4, fig. 4.



*Dendrocrinus Oswegoensis.*
Diagram showing structure of body.

BODY obconic, but rather widely truncated for the reception of the column at the base. Basal pieces very short, or only forming a mere ring, not very readily distinguished from the upper joint of the column. Subradial pieces comparatively large, as wide as long, four of them hexagonal, and one on the anal side heptagonal, the latter being truncated above for the reception of the first anal piece; the angle at the middle of the under side of each of them very obtuse, or nearly obsolete. First radial pieces nearly as large as the subradials, a little wider than long, of nearly equal size, and all pentagonal, or with occasionally one of the superior lateral angles truncated, so as to form a sixth angle; each, in four of the rays, seem to support on its superior broadly truncated side, in direct succession, a series of much shorter, but equally wide radials, the number of which is unknown, though in three of the rays of the specimen described, two of the pieces are left, all the others being broken away. In the fifth ray (immediately on the right of the anal series) the second radial piece seems to have been of a different form from those of the other rays; but the specimen is too imperfect to show its true nature. First anal piece about two-thirds as large as the subradials, hexagonal, and resting upon the superior truncated side of one of the subradials, between two of the first radials, and connecting on the right above with a second radial; sutures slightly indented at the corners of the plates. Column, near the base, rather large, round, and provided with a very distinctly five-rayed, star-shaped central canal. (Other parts unknown).

This species differs considerably in its general physiognomy from the typical forms upon which the genus *Dendrocrinus* was founded, particularly in the great breadth of the radial pieces above the proper body of the crinoid. Some of the species described by Mr. Billings, however, with the structure of *Dendrocrinus*, show gradations in this character, between these forms, with broad, nearly flat radial pieces, in contact all around below the first bifurcation, excepting on the anal side, and those with slender rounded arms and free rays, as in the typical species. Similar differences are also observed among the species of several of the Carboniferous genera.

Specifically, this form seems to agree most nearly with *D. latibrachiatus*, of Billings, from which it differs in its proportionally much shorter and wider basal pieces, and its much larger size, as well as more robust aspect. It also differs in having the sutures at the meeting of the corners of the plates a little indented.

*Locality and position:* Oswego, Kendall county, Illinois; in the Cincinnati Group of the Lower Silurian series.

# MOLLUSCA.

## BRACHIOPODA.

### GENUS STROPHOMENA, Rafinesque, 1820. ?

(*Strophomenes*, R.—*Strophomena*, BLAINV. (1825), Malac. p. 518.)

### STROPHOMENA UNICOSTATA, M. and W.

Pl. 4, fig. 11 *a*, *b*.

SHELL transversely subsemicircular, the greatest breadth being on the hinge margin, which terminates in rather acutely angular extremities; lateral margins generally nearly straight, or more or less concave in outline, and converging from the extremities of the hinge to the front, which is rounded, a little straightened, or slightly sinuous in the middle; geniculation of both valves from the ventral side, very abrupt all around the anterior and lateral margins, to near the extremities of the hinge. Ventral valve almost perfectly flat, and without any traces of concentric wrinkling on the disc between the hinge and the geniculated front and lateral margins; beak very small, or scarcely distinct from the cardinal margin, and showing the usual minute perforation; area narrow, but a little wider than that of the other valve, and slightly arched, and provided with a rather wide triangular fissure, closed by the convex pseudo-deltidium and the cardinal process of the other valve. Dorsal valve with the disc or visceral region flattened, and, like that of the other valve, without any traces of concentric undulations; deflected anterior and lateral margins conforming nearly to those of the other valve; beak nearly obsolete; area linear, and provided with a marginal furrow for the reception of the edge of the other valve; cardinal process rather small, cordate or bilobed, with the socket on each side for the reception of the teeth of the other valve well defined; interior with muscular scars generally moderately distinct (the cavity for their reception represented too small in fig. 11 *b*), and separated by a small mesial ridge; other parts of the visceral region occupied by rather crowded granules. Surface of both valves ornamented by fine, crowded, radiating striæ, which increase by intercalation and division, while one of those on the middle of the ventral valve is generally five or six times as large as the others, and really forms a distinct mesial rib.

Breadth of largest specimen seen, 1.28 inch; length, 0.56 inch; number of striæ in 0.10 inch, on the disc of the ventral valve near the deflected edge, 12 to 16.

This species will be readily distinguished from *L. rhomboidalis*, and other allied forms, by having its flattened disc of both valves always (as shown by a large series of specimens) without any traces of concentric undulations or wrinkles, and particularly by its single mesial rib on the outside of the ventral valve. These characters, being constant, in a large number of individuals, found at different localities, lead us to regard it as a distinct species from any of those yet defined, with which we are acquainted.

We retain the name *Strophomena* for this group, rather from deference to various high authorities in Palæontology, who range such shells under that name, than from being clearly satisfied that they properly belong to the genus so named by Rafinesque. At any rate they present quite a different physiognomy from the forms usually referred to that genus, such as *L. alternata*, in their flattened disc, abruptly geniculated front and lateral margins, and visceral region margined by a distinct ridge, as well as in some other characters. Rafinesque defined his genus, and the species he ranged under it, so loosely and briefly, that it is impossible for any one, from his descriptions, (which were not accompanied by figures), to be positively sure exactly what type he had in view, while he did not cite any known species, or refer to any published figure. In such cases it has been the general custom of naturalists to follow the first succeeding author who adopted the genus, with an intelligible description, figure or citation, in deciding in regard to the particular type for which the name is to be retained. The first author who adopted *Strophomena* after Rafinesque was Defrance, in 1824, but he did it in a mere list, without figures or description. In 1825, however, Blainville adopted the genus in his Malacology, giving a description of the genus, and figures of a species (*rugosa*, Raf.) Hence it is to this type we must go if we adopt the genus at all. But a moment's examination of Blainville's figures will convince any one that they do not represent one of these peculiar forms like that under consideration, but a resupinate shell, with a wide Orthis-like area, similar to *S. planumbona* of Hall, if not indeed that very species, which Prof. Hall now thinks related to *Streptorhynchus*. It is therefore evident that, unless this shell is congeneric with such forms as *S. rhomboidalis*,=(*S. depressa*, of authors), our species cannot be properly ranged in the same genus. We have the impression that a proper application of the rules of nomenclature would require that Dalman's name *Leptæna* should be retained for the group of which *S. rhomboidalis* is the type. (A conclusion already adopted, we believe, by Prof. Shaler in one of the Bulletins of the Cambridge Museum.) If so, our species here described will have to be called *Leptæna unicostata*.

*Locality and position:* Savannah, Illinois; in the Cincinnati Group of the Lower Silurian. It also occurs at the same horizon in Iowa.

# LAMELLIBRANCHIATA.

## GENUS AMBONYCHIA, Hall, 1847.

(Palæont. N. Y., vol. I, p. 163.)

## SUBGENUS MEGAPTERA, M. and W., 1866.

Pl. 4, fig. 9 *a*, *b*.

### MEGAPTERA CASEI, M. and W.

*Ambonychia* (*Megaptera*) *Casei*, MEEK and WORTHEN, March, 1866. Proceed. Chicago Acad. Sci., vol. I, p. 22.

SHELL trigonal, compressed, subequivalve, extremely inequilateral, posterior side long, compressed and strongly alate; the wing very large, produced, pointed, and not separated from the alate posterior margin by a distinctly defined sinus; margin below the wing, sloping obliquely forward to the basal angle; cardinal margin the longest part of the shell, straight and much compressed from immediately behind the beaks. Anterior side truncated nearly vertically from the beaks, about half way down the front, thence sloping slightly backwards to the basal angle. Basal margin produced downwards, and terminating in a distinct angle, slightly in advance of the middle. Umbonal slopes very prominent, angular, or sometimes apparently bicarinate, straight, and extending from the beaks, near the anterior margin, to the most prominent part of the base, ranging at an angle of about 65° below the horizon of the hinge-line, and provided with a longitudinal sulcus below the middle of the valves. Beaks straight, rising a little above the cardinal margin, and quite terminal. Surface ornamented with distinct, irregular, alternately larger and smaller, thread-like radiating striæ, with less distinct concentric lines, and a few distinct, stronger marks of growth, which sometimes form prominent, imbricating, subspinous projections on the umbonal angle.

Length, as inferred from the direction of the lines of growth, about 2 inches; height, 1.73 inch; convexity, 0.64 inch.

We consider this curious shell to be the type of a new subgenus, which we were first inclined to place under *Pterinea*, but on examining some internal casts, we ascertained it has the hinge teeth (at any rate those just in front of the beaks) of *Ambonychia*, while it shows no traces of the deep-seated, oblique posterior teeth, or of the strong anterior muscular impression and anterior ear of *Pterinea*. In form it approaches more nearly *Pteronites*, of McCoy, but as it is much less oblique, and has the posterior wing greatly more produced than the Carboniferous types upon which that genus was originally founded, while its beaks are quite terminal, and there appears to be no little lobe or ear in front of them, we have concluded to leave it provisionally under *Ambonychia*. From the typical forms of that genus, however, it differs extremely, in the great development of its posterior wing.

None of the specimens give any indications of the valves gaping in front, unless it may have been very near the beaks, where there is probably a small anterior wing. One cast shows some appearance of the impression of the adductor muscle, occupying a sub-central position back of the umbonal ridge, on the alate portion of the shell; while another shows the pallial line extending around up the front, nearly to the inner apex of each beak.

Named in honor of Mr. L. B. Case, of Richmond, Indiana, who discovered the only specimens of this species we have seen.

*Locality and position:* Richmond, Indiana; upper part of the Cincinnati Group (Hudson River Group, as formerly understood). Lower Silurian.

## GENUS DOLABRA, McCoy, 1844.

(Carb. Foss. Ireland, p. 64.)

### DOLABRA STERLINGENSIS, M. and W.

Pl. 4, fig. 10 *a*, *b*, *c*.

*Dolabra sterlingensis*, MEEK and WORTHEN, July, 1866. Proceed. Acad. Nat. Sci., Philad., p. 260.

SHELL rhombic-cordate, being cordate in outline, as seen in an anterior and posterior view, and obliquely rhomboidal, as seen from either side. Posterior margin obliquely truncated, with a long slope, which is slightly convex above, and faintly sinuous near the middle; posterior basal extremity produced obliquely backwards and downwards, with a more narrowly rounded or sub-angular outline; basal margin ascending forward, with a moderately convex curve, and rounding up more or less gradually into the very short or almost obsolete anterior side; hinge line short; cardinal area moderately developed. Beaks prominent, placed nearly over the anterior margin, strongly incurved, and compressed antero-posteriorly; umbonal ridges very prominent, sub-angular, and extending from the beaks obliquely to the posterior basal extremity, at an angle of about 45° below the horizon of the hinge, thus dividing each valve into two subequal areas, of which the one behind is flattened or slightly concave between the ridge and the moderately prominent postero-dorsal edge, and that in front and below it convex. Surface marked with concentric striæ of growth. (Hinge and interior unknown).

Greatest length, measuring obliquely from the beaks to the posterior basal extremity, 2.20 inches; diameter at right-angles to the same, 1.50 inch; convexity of the two valves when closed, 1.50 inch.

This species is evidently related to *Cyrtodonta Hindi*, of Billings (see Palæozoic Fossils of Canada vol. I, p. 151, fig. 131 *a*, *b*), from the same geological horizon. It differs, however, in several important specific characters, being proportionally much more gibbous, shorter, and, in consequence of its hinge line forming a wider angle with its umbonal axis, distinctly less oblique. It also differs in having its anterior side much less prominent and more broadly rounded below the beaks, which consequently have the appearance of being almost terminal. Its beaks are likewise more compressed antero-posteriorly, and its hinge line shorter. Our specimen does not show the cardinal area very satisfactorily, though it is evidently moderately well developed, and shorter than in Mr. Billings' species.

Until the hinge and interior of this shell can be examined, it is scarcely possible to determine very clearly its generic character, but on comparison with *Cucullæa angustata*, Sowerby, the type of McCoy's genus, *Dolabra*,* and other more obliquely truncated species, such as *C. unilateralis*, Sowerby, *C. amygdalina*, Phillips, as figured in Phillips' Palæozoic Fossils, we can scarcely doubt the propriety of referring it to the genus *Dolabra*. Some of these species have much the form and general external appearance of the genus *Cucullæa*; while Sowerby's figure of an internal cast of the so-called *C. angustata* (Geol. Trans. (2), vol. V, pl. 53, fig. 25), seem to indicate a very similar hinge to that of *Cucullæa*. They appear to want the prominent posterior muscular support and the radiating costæ or striæ of the more modern species of true *Cucullæa*, of which, however, they are evidently palæozoic representatives.

*Locality and position:* Cincinnati group, of Lower Silurian series; at Sterling, Illinois.

# GASTEROPODA.

## ? GENUS CYRTOLITES, Conrad, 1838.

(Ann. Report Palæont. N. Y., p. 118.)

### CYRTOLITES IMBRICATUS, M. and W.

Pl. 4, fig. 12.

SHELL subdiscoid; volutions from three to three and a half, increasing rapidly in size—their dorso-ventral diameter being to the transverse as 50 to 40; inner ones nearly half embraced by the last turn; all having the dorsal carina well defined, and the greatest convexity near, or a little within, the middle of each side, which is sub-angular, excepting near the aperture on the last whorl. Umbilicus moderately wide, and rather deep basin-shaped, showing about half of each inner turn. Surface ornamented by numerous raised, undulated, and vaulted lamellæ, rather irregularly disposed, and becoming crowded and distinctly imbricating near the aperture.

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* The genus *Dolabra*, as first proposed by Prof. McCoy, included along with the typical species, such as *Cucullæa angustata*, and *C. unilateralis*, Sowerby, *C. amygdalina*, Phillips, etc., other forms belonging to the subsequently established genus, *Schizodus*, King. After the separation of the latter group, however, the name *Dolabra* was of course left for the other genus.

Greatest diameter, 0.86 inch; convexity, about 0.40 inch; dorso-ventral diameter of the last turn, near the aperture, 0.50 inch.

This species is related to the well known *C. compressus*, Conrad, from which it differs materially in the much more rapid increase of the dorso-ventral diameter of its volutions, as well as in having the inner sides of its whorls sloping into the umbilicus from the most prominent sub-angular central region, instead of rounding abruptly into the same. Its lamellæ, although strongly undulated, are less regularly so than in *C. compressus*; while they are more prominent, irregular, and more distinctly imbricating, near the aperture. These lamellæ are not well represented in the figure.

*Locality and position:* Alexander county, Illinois; Cincinnati group of the Lower Silurian series.

# PTEROPODA.

## GENUS TENTACULITES, Schlotheim, 1820.

(Petref., p. 377.)

### TENTACULITES TENUISTRIATUS, M. and W.

Pl. 4, fig. 7 *a*, *b*.

*Tentaculites tenuistriatus*, MEEK and WORTHEN, 1865. Proceed. Acad. Nat. Sci., p. 254.

SHELL attaining a rather large size, gradually tapering, and a little curved; annulations large, prominent, rather obtuse near the smaller end; separated by rounded constrictions of about 0.10 inch breadth at the larger extremity of a specimen one inch or more in length. Surface marked by numerous, very fine, regular, closely arranged longitudinal striæ, most distinctly marked in the rounded depressions between the annulations. Aperture circular.

Length, 1.16 inches; breadth at the aperture, measuring upon one of the rings, 0.25 inch; do., between the rings, 0.19 inch; space occupied by four rings, and the three intervening spaces at the larger end, 0.30 inch; while the same space includes six rings at the smaller end.

This species resembles rather closely the enlarged figure of a form from the same horizon, referred by Prof. Hall to his *T. flexuosus*, (pl. 78, fig. 2 *b*, Palæont. N. Y., vol. I); but its annulations are sharper, and its longitudinal striæ more crowded; while the natural size of the New York species is much smaller.

Dr. Shumard has also described, under the name *T. incurvus* (Missouri Report, p. 195), a similar form, though his species is much smaller, with more crowded rings, while it also differs in having minute annular striæ.

*Locality and position:* Cincinnati Group of Lower Silurian series; Alexander county, Illinois.

## TENTACULITES OSWEGOENSIS, M. and W.

Pl. 4, fig. 6 *a*.

*Tentaculites Oswegoensis*, MEEK and WORTHEN, 1865. Proceedings Acad. Nat. Sci., Philad., p. 254.

SHELL attaining a rather large size, very gradually tapering to an acute point, distinctly arched, particularly towards the smaller extremity; section circular; annulations rather prominent, somewhat obtuse, from three to three and a half in a space equaling the transverse diameter, diminishing very regularly in size, and in their distance apart, from the larger to the smaller extremity. Surface without longitudinal or (visible) transverse striæ.

Length, 1.45 inches; greatest transverse diameter, 0.16 inch; space occupied by six annulations, and five of the intermediate constrictions, at the larger end, 0.35 inch.

This species has much the general appearance of curved individuals of *T. elongatus*, Hall, from the Lower Helderburg group (Upper Silurian), of New York, but is decidedly more strongly arched, proportionally more slender, and has more closely arranged annulations, while it shows no traces of the annular striæ seen on the New York species.

From our *T. tenuistriatus*, described on the preceding page, it will be distinguished by its more slender form, more closely arranged rings, and the absence of longitudinal striæ. The last mentioned character, and its much larger size, will also distinguish it from *T. incurvus*, of Shumard, (Missouri Geological Report, pl. *B*, fig 6 *a*, *b*.)

*Locality and position:* Oswego, Kendall county, Illinois; in the Cincinnati group of the Lower Silurian.

## TENTACULITES STERLINGENSIS, M. and W.

Pl. 4, fig. 8.

*Tentaculites Sterlingensis*, MEEK and WORTHEN, 1865. Proceedings Acad. Nat. Sci., Philad., p. 255.

SHELL small, slightly arched, and gradually tapering to a point; section circular; annulations prominent, angular, rising abruptly from the surface, usually about their own breadth apart; constrictions between the annulations, with fine, sharply elevated, longitudinal striæ, which are not continued upon the rings.

Length, 0.56 inch; breadth at the larger end, 0.08 inch; annulations five in the space of one-eighth of an inch, at the larger end, and nine or ten in the same space at the smaller end. Longitudinal striæ, five in the space of 0.02 inch.

It is not improbable that this will prove to be the form from the so-called Hudson River group, referred by Prof. Hall to his *T. flexuosus*, in vol. I, p. 284, Palæont. N. Y. As that specific name, however, was founded upon a Trenton fossil, described as being septate, and having nine rings in one-eighth of an inch (being, as is now supposed, the column of a *Cystidian*), the name *flexuosus* could not be properly applied to this form, which is a true *Tentaculite.*

It will be distinguished from *T. incurvus*, of Shumard, from the Cape Girardeau limestone, which it resembles in size and form, by having its annulations arranged about their own breadth, instead of twice that distance apart, as well as in having the longitudinal striæ only defined *between* the rings, instead of of also *upon* them.

It seems to be *very* closely allied to *T. distans*, Hall, of the Clinton group, but differs in being curved instead of straight, as well as in being less rapidly expanding towards the larger end.

From the last of the two foregoing species it will be readily distinguished by its much smaller size, more sharply elevated rings, and distinct longitudinal striæ.

*Locality and position:* Sterling, Illinois; Cincinnati group of the Lower Silurian series.

# UPPER SILURIAN SPECIES.

## FOSSILS OF THE NIAGARA GROUP.

## PROTOZOA.

### SPONGIÆ.

### GENUS ASTYLOSPONGIA, Roemer.

(Sil. Fauna West. Tenn., p. 7.)

### ASTYLOSPONGIA ?? CHRISTIANI, M. and W.

Pl. 5, fig. 3 *a*, *b*, *c*.

ELONGATE-SUBOVATE, approaching an elliptic outline, rounded at the extremities; irregularly divided longitudinally by narrow, moderately deep furrows, into about eight lobes. Furrows straight, or more or less oblique, and a little flexuous, not converging regularly to a point at each extremity, but becoming more curved or flexuous near the ends, so as to impart a somewhat twisted appearance to the extremities; usually extending the entire length, but a few of them shorter, or not more than half the length of the fossil, the shorter ones generally starting from one end and terminating near the middle. Surface apparently smooth. Internal structure unknown.

Length, 1.22 inches; greatest breadth, 0.66 inch.

At the same time that we refer this fossil, provisionally, to the genus *Astylospongia*, we have many doubts in regard to its relations to that group, or even whether it is really a sponge at all or not, as we have not been able to see any structure in it, beyond the fine granular appearance of the magnesian limestone from which it was obtained. The slightly twisted character of its longitudinal furrows, produces some remote resemblance to the internal casts of those curious pear-shaped *Cystidians*, for which the name *Gomphocystites* has been proposed, and suggests the inquiry whether it may not be an internal cast of an allied *Cystidian*. Until other specimens, showing something more of its structure, can be examined, however, it seems scarcely possible to decide positively in regard to its true nature.

Named in honor of Mr. J. B. Christian of Mt. Carroll, to whom we are indebted for the only specimen we have seen.

*Locality and position:* Niagara group; Carroll county, Illinois.

### (*Incerta sedes.*)

## GENUS PASCEOLUS, Billings, 1853.

(Canadian Geol. Rep., p. 342.)

### PACEOLUS? DACTYLIOIDES, Owen (sp.).

Pl. 5, fig. 2 *a*, *b*, *c*.

*Lunulites? dactioloides*, OWEN, 1844. Report Geol. Expl. Iowa, Wis. and Illinois (Octavo), p. 69, pl. XIII, fig. 4.

HEMISPHERICAL, the under side being flat or nearly so, and the other convex, while the periphery is rather sharply rounded, or subangular. Entire surface occupied by regular, closely crowded, hexagonal pits, or shallow depressions, separated by slender raised divisions. On the upper convex side these pits are of uniform size, and each one perforated in the middle by a minute circular opening passing into the interior; while those of the under or flat side are imperforate, and diminish in size from the periphery towards the center. They also differ from those above, in showing a slight tendency to arrange themselves into curved lines crossing each other, as in *Receptaculites*, from which, however, they differ in being distinctly hexagonal.

Height, or convexity, 0.50 inch; greatest breadth, 1.17 inches.

Although Dr. Owen's figure of the fossil described by him under the name *Lunulites? dactioloides*, represents the cells as being nearly circular, and more distantly separated than those of the form under consideration, there is little room to doubt, judging from his description—("truncated spherical, with five or six-sided cellular depressions in rows around the circumference, like those of a thimble")—that it is really the same, especially since it came from the same rock, and is the only fossil resembling his figure yet known from this horizon.

In regard to its zoological relations, however, we are in considerable doubt, and we only place it provisionally in Mr. Billings' genus *Pasceolus*, because it presents much the same general appearance, while we are not sure whether it is, as we now see it, merely a cast of the interior, or of the exterior. If the former, it may have been incased in a shell composed of solid hexagonal plates as in *Pasceolus;* but if it is a cast of the exterior, it would be widely different from that type, in having the whole surface occupied by hexagonal pits, instead of solid convex plates. Even if covered by plates, however, it would still differ from *Pasceolus* in having these plates, on the under side, diminishing in size to the center, and showing a tendency to range themselves in curved lines, like the cells in *Receptaculites.* It differs very decidedly from the latter, however, in having the pits of the surface all hexagonal, instead of quadrangular or rhombic, while we have no reason to believe that it has any of the internal characters of that genus.

It is possible our fossil should be referred to Eichwald's genus *Cyclocrinites*, but we are left in doubt on this point, because *Cyclocrinites* is not only said to be covered with plates, but to be provided with openings like the *Cystidians*, to which group it is generally referred by good authorities.* We can scarcely believe it possible that the fossil under consideration had any other openings than the minute perforations in the middle of the depressions of the upper side, or is in any way related to the *Cystoidea.* Mr. Billings, to whom we sent drawings of it, for comparison with his genus *Pasceolus*, writes that he thinks it most probably generically distinct from that type, and a new genus, holding an intermediate position between *Pasceolus* and *Receptaculites.* We are strongly inclined to adopt this view, but prefer to place it, provisionally, for the present, until other specimens giving more satisfactory information in regard to its structure can be obtained, under *Pasceolus.* In case it shall be found distinct from all the genera with which we have compared it, we would propose to call it *Cerionites*, in allusion to its resemblance to honey-comb.

If *Tetradium* and *Receptaculites* are sponges, as has been suggested by some, this type will doubtless also be found to belong to the same section of that group.

*Locality and position:* Niagara group of the Upper Silurian; Carroll county, Illinois.

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* *Pasceolus* has also been referred by Mr. Niles and Prof. Verrill to *Cyclocrinites*, but Mr. Billings thinks it destitute of the openings characterizing that group.

# RADIATA.

## ECHINODERMATA.

### GENUS SACCOCRINUS, Hall, 1852.

(Palæont. N. Y., vol. II, p. 205.)

In some of his later publications, Prof. Hall abandons this genus, and refers one of the species (*S. Christyi*) to *Actinocrinus*. Although, in the form, number and arrangement of the plates composing the body of these crinoids, they agree very closely with *Actinocrinus*, they still differ so materially in the elongate, sack-like form of their body, as to present a peculiar physiognomy, readily distinguishing them from the typical Carboniferous forms upon which the genus *Actinocrinus* was originally founded. In addition to this, at least the only species the arms of which are known to us (*S. speciosus*, Hall), differs from the typical species of *Actinocrinus*, in having their divisions bifurcating *after they have passed into a double series of interlocking pieces* The structure of the arms is perhaps not generally of much importance as a means of distinguishing the genera of crinoids, but the character of having each division, after passing into a double series, continued on without farther bifurcations, seems so constant in true *Actinocrinus*, as apparently to give more importance to the structure of these parts than in other groups. At any rate, these elongated Silurian forms are certainly separable from *Actinocrinus* upon better grounds than some of the Upper Silurian species, such, for instance, as *Homocrinus scoparius*, Hall, (vol. III, Palæont. N. Y., pl. 1), can be separated from *Poteriocrinus*. They are also distinguished, upon analogous characters of general physiognomy, and other more important peculiarities, from *Megistocrinus*, to which they have sometimes been referred.

### SACCOCRINUS CHRISTYI, Hall? (sp.)

Pl. 5, fig. 1.

*Actinocrinus Christyi*, HALL, 1863. Trans. Albany Inst., vol. V, p. 196; (not SHUMARD, 1855.)
*Actinocrinus Whitfieldi*, HALL, 1865. Eighteenth Rep. Regents Univ., N. Y., on State Cab. Nat. Hist.

BODY attaining a large size, elongate, obconical; without any constriction below the arm bases, which are abruptly spreading, with more or less deep sinuses between those belonging to the principal divisions of the rays and a larger one between the two posterior rays, on the anal side. Base (in internal casts) somewhat rounded, and only moderately prominent, its plates being more spreading than those of the next series above. First radial plates comparatively large, longer than wide, two heptagonal and three hexagonal, the upper truncated side of each being short. Second radials larger than wide, about half as large as the first radials, and (all?) hexagonal, with the upper and lower sides shorter than the others. Third radial pieces one-half to two-thirds as large as the second, about as long as wide, and generally heptagonal in form; the upper sloping sides of each supporting two secondary radials, each of which is succeeded by another, upon which a second bifurcation takes place; in the inner two of these last divisions there are apparently, in direct succession, three small tertiary radials, the last of which supports two free arms, while in each of the two outer divisions there appear to be two tertiary radials or brachial pieces, the last of which supports a single free arm, thus making (at least in the anterior and lateral rays) six arms to each ray.

Interradial pieces about ten to each interradial space; the first one generally slightly larger and proportionally wider than the second radials, hexagonal in form, and each supporting two smaller hexagonal and pentagonal pieces in the next range, above which the others are placed two in each range, and diminish rapidly in size as they pass up between the rays to connect with the vault. There are also, in each interaxillary space, some five or six smaller pieces, and one in some of the interbrachial spaces.

Anal series unknown, beyond the fact that they are numerous and comparatively small above the second or third range.

Vault flat, or nearly so, and composed of numerous small pieces; its opening placed between the middle and the anal side, and apparently provided with a proboscis.

Length from base to arm bases (internal cast), 2.26 inches; greatest breadth of do. just below arm bases, 1.50 inches.

As we know this crinoid mainly from internal casts, we can not be quite sure in regard to the nature of its external surface. On one specimen, however, apparently of the same species, we observe remains of a distinct linear ridge, extending up each of the radial series of plates and their bifurcations to the arm bases. Although the base is somewhat rounded in the internal casts, it was doubtless truncated below for the connection of the column, in specimens retaining the plates. In casts, the area of each plate is slightly concave, and the positions of the sutures between are marked by a raised line.

In general appearance this form nearly resembles *S.* (*Megestocrinus*) *infelix* of Winchell and Marcy, which Prof. Hall thinks not distinct from his *S. Christyi*, but it differs from the description of *S. infelix* in having eight or ten more arms. It would also differ in the same character from *S. Christyi*, if the number of the arms in that species has been correctly made out. As Prof. Hall seems to have been in some doubt, however, on this point, we have concluded to refer our specimens provisionally to *S. Christyi*, for the present, and if this form should hereafter prove distinct, it may be called *S. sacculus*.

In a tolerably well preserved specimen of *S. Christyi*, now before us, from Waldron, Indiana (the original locality), and apparently agreeing in all its other known characters with the description of that species, we observe obscure but unmistakable indications of numerous fine striæ radiating from the central region to the sides of all the larger plates—those passing to any one side being all parallel with each other. These lines might be readily overlooked, and, where the surface has been slightly worn, they would always be entirely obsolete. Prof. Hall mentions no such character in the description of his species, though it might not have been preserved on his specimens.

*Locality and position:* Bridgeport, near Chicago, Illinois; in the limestone of the age of the Niagara group of the Upper Silurian series.

# MOLLUSCA.

## BRACHIOPODA.

### GENUS HEMIPRONITES, Pander, 1830.*

(Beitr. Zur. Geol. Russ., p. 25.)

### HEMIPRONITES SUBPLANUS, Conrad? (sp.).

Pl. 6, fig. 6 *a*, *b*.

*Strophomena subplana*, CONRAD, 1842. Jour. Acad. Nat. Sci., Philad., VIII, p. 258; HALL, 1843, Geol. Report, 4 Dist. New York, p. 104, fig. 1.

*Leptæna subplana*, HALL, 1852. Palæont. N. Y., vol. 2d, p. 259, pl. 53, fig. 8–10.

*Strophomea* (*Streptorhynchus*) *subplana*, HALL, 1862. Geol. Report Wisconsin, p. 437.

SHELL semioval, or more than semicircular in outline, compressed, resupinate, subequivalve, approaching plano-convex;

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* This is the same genus named *Streptorhynchus* by Prof. King, in 1850.

hinge line about equaling the greatest breadth of the valves at any point farther forward; front and anterior lateral margins forming a regular semicircular curve. Ventral valve nearly flat, or a little convex at the umbo, and slightly concave towards the front; beak not projecting beyond, nor very distinct from, the cardinal margin; cardinal area (mainly hidden in the matrix in our specimens) apparently of moderate breadth, inclined backwards, and extending to the extremities of the hinge. Dorsal valve slightly and rather evenly convex; beak not distinct from the cardinal margin. Surface of both valves ornamented with distinct, abruptly raised radiating striæ, with flat intervening depressions, in which there are generally from one to three or four smaller and shorter striæ, one of which is sometimes nearly as large at the border as the principal ones, but soon becomes smaller, and generally dies out near the middle of the valves, while the smallest ones are still shorter; crossing all of these, there are numerous extremely fine, regular, closely arranged concentric striæ.

Breadth of one of the largest specimens, 1.30 inches; length, 1.05 inches; convexity, 0.18 inch.

As we have not seen the hinge and interior of this shell, we are not sure that it belongs to the genus *Hemipronites*=(*Streptorhynchus*). From its resemblance to *H. subplanus*, of New York, however, which has been referred by Prof. Hall to *Streptorhynchus*, we are led to place it in that genus. We strongly suspect, however, that it will be found to be, at least specifically, distinct from the New York species, and it is only because that shell is said to vary in the nature of its striæ that we have concluded to refer ours, even provisionally, to *H. subplanus*. On comparison with one authentic New York specimen of that species, and several good examples of the form from Waldron, Indiana, generally identified with it, we find our shell differs in the following characters:—in the first place, it is distinctly less extended on the hinge line in proportion to the length of its valves. Its striæ also differ in presenting a greater inequality between the size of the largest or primary ones, that extend entirely to the beaks, and the smaller; while the spaces between them all are generally wider, and more flattened, and the concentric striæ slightly smaller and more crowded. Those on each side of the umbones are likewise generally a little more curved. Our specimens are in nearly all cases more or less exfoliated, and in this condition the striæ seem to be very abruptly elevated, and narrower than the flattened spaces between. In one specimen, however, there are some remaining portions of the external surface of the shell, and on this the striæ, although prominent, are proportionally wider, and apparently rather distinctly flattened on top.

Should this form prove to be distinct from the *H. subplanus*, we would propose for it the name *Hemipronites* (or *Streptorhyncus*) *propinquus*.

*Locality and position:* Dark gray limestone at Thebes, Alexander county, Illinois; apparently of the age of the Niagara division of the Upper Silurian.

## GENUS OBOLUS, Eichwald, 1829.

(Zool. Spec. 1, p. 274.)

### OBOLUS [TRIMERELLA ?] CONRADI, Hall.

Pl. 5, fig. 7 *a*, *b*.

*Obolus Conradi*, HALL, 1868. Twentieth Rep. Regents Univ. N. Y., on State Cab. N. H., p. 368, pl. 13, fig. 2.

SHELL large, orbicular, or slightly wider than long, lenticular; surface with obscure concentric marks of growth; beaks very small and but slightly prominent; thickened cardinal marginal narrow. Muscular and other scars in the central region of the valves very strongly defined.

Breadth, 1.53 inches; length, 1.30 inches; convexity, about 0.65 inch. Some specimens show that it attained a third larger size, however, than that from which these measurements were taken.

Our specimens of this shell are only internal casts, and moulds of the exterior in the matrix. These casts are in various conditions of preservation, and from this fact and individual variations, the impressions of the internal markings differ considerably, as may be seen by comparing our figure with Prof. Hall's. We do not believe these differences, however, to be specific. At first we were struck with their similarity to *Obolus Davidsoni* of Salter, but, on comparing a good series of specimens with Mr. Davidson's figures of casts of that species, it will be easy to see that they are distinct. In the first place, its two central muscular scars have a different form, and in some better specimens (more recently obtained) than that we have figured, they are marked with distinct radiating striæ, like those of the cardinal muscles in some species of *Chonetes* and *Strophomena*. As in *O. Davidsoni*, these muscular scars are situated one on each side of a rather broad, rounded ridge in the cast, (a raised furrow in the shell.) In well preserved internal casts, however, there are two more or less projecting free processes, extending back so as nearly or quite to cover the muscular scars, exactly as in *Trimerella* of Billings, excepting that they are shorter. In the specimen from which our figure was drawn, these are broken away. They evidently occupied deep cavities extending back under the muscular scars, which were thus, as it were, upon a kind of broad horizontal septum, supported by a thick mesial partition. These processes (casts of cavities) are always more or less developed in our well preserved specimens, and, when not broken away, as in the specimen figured on pl. 6, give these casts a very different appearance from those represented by Mr. Davidson's figures of *O. Davidsoni.*

From the gradations, however, in this character, exhibited in our specimens, which in nearly all their other characters so closely resemble *O. Davidsoni*, we can scarcely doubt the generic identity of our shell with *Trimerella*, which only differs in this respect in the *degree* of the development of this character. At any rate, we have, from the same locality and position as that from which the form under consideration was obtained, casts of a more oval (larger) species, agreeing exactly with the characters of *Trimerella*, and yet we would scarcely separate them more than specifically from the species here described.

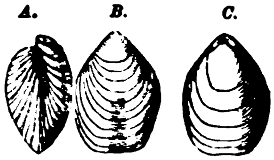
*Locality and position:* Port Byron, Illinois, and Leclaire, Iowa; Niagara division of the Upper Silurian.

## GENUS CENTRONELLA, Billings, 1859.

(Canadian Naturalist, p. 181.)

### CENTRONELLA BILLINGSIANA, M. and W.

Pl. 6, fig. 5 *a*, *b*, *c*, and the following cuts.



*Centronella Billingsiana.*
*A*, profile view. *B*, ventral view. *C*, dorsal view.

SHELL attaining a moderately large size, subovate in form; valves nearly equally convex, the ventral being a little more gibbous than the other, particularly in the umbonal region; greatest breadth near the middle, or slightly in advance of it; posterior lateral slopes nearly straight, or sometimes a little concave in outline, and converging to the beaks at various angles of from 70° to 80°; front usually rather narrowly rounded, faintly subtruncate, or very slightly sinuous. Dorsal valve regularly convex, and without any traces of a sinus or mesial ridge; beak rather gibbous and distinctly incurved. Ventral valve with a shallow, rather narrow mesial sinus, generally moderately well defined at the front, and extending to the central region, where it gradually becomes obsolete; beak moderately prominent, rather pointed, somewhat arched, with apparently a very small perforation at the extremity, connected when the deltidium is removed, with a comparatively large triangular opening extending to the incurved beak of the opposite valve. Surface of both valves marked with obscure concentric striæ of growth.

Length of the largest specimen in the collection, 0.63 inch; breadth, 0.50 inch; convexity, 0.34 inch.

The internal characters of this shell are unknown to us, but it presents the form and other external appearances of the genus *Centronella.* It may be at once distinguished from *C. glans-faga* and *C. hecate*—the typical species of the genus—by its larger size, more nearly equivalve form, and gibbous dorsal valve. It is much more nearly allied to a form for which Mr. Billings has proposed the name *C. tumida* (Devonian Fossils of Canada West, p. 63, fig. 98), but differs in having no traces of a mesial sulcus on the dorsal valve, nor of a ridge on the ventral. It is also less gibbous.

Our figures on plate 6 do not give a very accurate representation of this species; consequently we have had the foregoing cuts prepared. Fig. 5 *a*, of the plate, is too broadly rounded in front, and has the posterior lateral slopes rather too concave in outline, while the shading makes the ventral beak look too flat, and the figure under the beaks of that of the other valve too small.

*Locality and position:* Alexander county, Illinois, in a thin local bed of gray limestone; apparently near the horizon of the Niagara division of the Upper Silurian.

## GENUS MERISTELLA, Hall, 1860.

(Ann. Report Regents Univ. N. Y., on State Cab. N. H., p. 74.)

### MERISTELLA? (sp).

Pl. 6, fig. 4 *a*, *b*.

THE specimens of this shell yet obtained are too imperfect to be satisfactorily compared with the described species, or to be clearly characterized. It seems to have been moderately gibbous, and about as wide as long, with the ventral valve a little more convex than the other, and provided with a narrow, shallow mesial sinus, extending from the front nearly to the beak, which is somewhat pointed and closely curved over and upon that of the other valve. The surface shows fine, rather obscure concentric lines, and some stronger marks of growth, with (as seen under a magnifier, on exfoliated surfaces) obscure traces of minute radiating striæ, probably due to the fibrous structure of the shell, rather than to surface markings.

The figures on plate 6, drawn from a crushed and distorted specimen, do not convey a very correct idea of this shell, being too narrow in proportion to the length, and not convex enough, while the narrow sinus of the ventral valve (fig. 4 *b*) is made, by erroneous shading, to look too sharply defined, like a mere stripe of color.

*Locality and position:* Same as last.

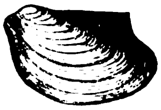
# LAMELLIBRANCHIATA.

## GENUS PTERINEA, Goldfuss, 1832.

(Naturh. Atl., taf. 812.)

### PTERINEA THEBESENSIS, M. and W.

Pl. 6, fig. 8, and annexed cut.



*Pterinea Thebesensis.*
Cut of the left valve, natural size.

SHELL (left valve) obliquely rhombic-oval, longer than high, moderately convex in the central and umbonal regions; cardinal margin less than the greatest length, bordered behind by an obscure marginal ridge, and ranging very obliquely to the umbonal axis, or nearly parallel to the greater diameter of the valve; basal margin forming a broad semicircular curve; anterior side truncated, sometimes obliquely and sometimes nearly vertically, a little rounded at its rectangular connection with the hinge above—rather distinctly gaping (unless the margin of the other valve is warped inwards); posterior margin most prominent, and narrowly rounded below the wing; posterior wing abruptly flattened from the swell of the umbo, rectangular at the extremity, and considerably shorter than the margin below, from which it is separated by a faint oblique sinuosity; anterior wing a very short, inconspicuous, round, rather convex lobe, obscurely defined by a faint, oblique concavity, extending down from the anterior side of the beak, which is moderately convex, depressed, and placed about half way between the middle and the anterior extremity. Surface marked by fine concentric striæ, and near the anterior truncated (gaping?) margin, by rather distinct subimbricating marks of growth.

Length, 0.80 inch; height, 0.50 inch; convexity (of left valve), 0.20 inch.

This shell is related to such forms as *Pterinea? subplana* (=*Avicula subplana*, Hall, 2d vol. Palæont. N. Y., pl. 59, fig. 3 *a*, *b*), and some of the forms referred by Prof. McCoy to *Pterinea retroflexa*, Wahlenb. (sp). It differs from all of these shells, however, in having its posterior wing always considerably shorter than the margin of the valve below it, and in the peculiar truncation and apparent gap of the anterior margin. This appearance of a gap is not produced by an emargination, but by a lateral curve of the margin that gives a warped appearance to the valve, as seen from the front. If the other valve had its anterior margin laterally curved, so as to correspond to this, there may have been no gap, but in that case the other valve must have been concave, at least in front. In the comparative shortness of its posterior wing, our shell more nearly resembles *Posidonomya? rhomboidea*, Hall (2d vol. Palæont. N. Y., pl. 59, fig. 5), which is almost certainly a *Pterinea*. It differs, however, in having its posterior wing more abruptly flattened, and defined from the umbonal convexity, as well as in the warped (and gaping?) character of its anterior side, and its much less angular anterior wing.

The figure on plate 6, of this species, failing to represent the true characters of the shell, the annexed cut is added to illustrate it.

*Locality and position:* Same as the last two.

## GENUS AMBONYCHIA, Hall, 1847.

(Palæont. N. Y., vol. 1, p. 163.)

### AMBONYCHIA ACUTIROSTRIS, Hall.?

Pl. 5, fig. 8 *a*, *b*, and 9 *c*.

*Ambonychia mytiloides*, HALL, 1860. New species Foss. from the Niagara Gr. of Wisconsin, extr. from Geol. Report for 1859, p. 2; (not *A. mytiloides*, Hall, 1847, vol. 1, Palæont. N. Y., p. 315.)

*Ambonychia? mytiloidea*, HALL, 1862. Geol. Rep. Wisconsin, p. 437; WINCHELL and MARCY, 1865, Enumeration Foss., p. 108.

*Ambonychia acutirostra*, HALL, 1865. Report of Regents of Univ. of N. Y., on State Cab. of N. H., p. 336.

SHELL obliquely subovate, gibbous anteriorly and in the umbonal region, and more compressed posteriorly, and around to the base; hinge very short, and ranging obliquely at an angle of about thirty-five to forty degrees with the longer axis of the valves; posterior margin truncated or nearly straight, and declining at a very wide or scarcely perceptible angle from the extremity of the hinge above, and rounding below into the more or less regularly rounded posterior margin; anterior margin truncated immediately in front of the beaks (in casts), at something less than right angles to the hinge above, and sloping and rounding obliquely into the posterior basal margin below. Posterior hinge teeth short, three to each valve, placed at the posterior extremity of the hinge and ranging obliquely backwards and downwards; beaks very prominent, oblique, slightly incurved, and very nearly terminal. Surface unknown.

Length of internal cast, measuring obliquely from the beaks to the posterior basal margin, 1.74 inches; greatest antero-posterior diameter, measuring at right angles to the longitudinal diameter, 1.25 inches; convexity, 1.03 inches.

Our identifications of this species were originally made by comparison with Prof. Hall's descriptions only. A few days before these descriptions were sent to the press we had an opportunity to compare our specimens with his figure of *A. acutirostris*, published in the Twentieth Report Regents Univ. N. Y., on State Cabinet of Nat. History. From this figure we are left in some doubt in regard to the identity of our shell with Prof. Hall's species, though the differences are not so great as some defects in the outlines of our figures would indicate. The most important difference would appear to be observable in the more oblique direction of the hinge line in our shell. If this character be found constant, there would be little room for doubting the propriety of separating these shells specifically, in which case, that we have figured might be called *A ? obliquua.* That these shells really belong to the genus *Ambonychia* is doubtful, as suggested by Prof. Hall.

The defects alluded to in the outline of our figures consist in the too great prominence of the anterior basal margin of figure 8 *a*, as well as of the middle portion of the anterior side of fig. 8 *b*. The beaks of 8 *a* should also be more pointed, and slightly curved downwards at the immediate points. The impressions of the posterior hinge-teeth in fig. 8 *b* should range obliquely backwards and downwards. In some respects the specimen from which our figure 8 *b* was taken resembles a form figured by Prof. Hall under the name *A. aphæa*, in Twentieth Regents' Report, pl. 14, fig. 3, though it has a straighter hinge, and we have no doubt of its specific identity with that represented by fig. 8 *a*.

*Locality and position :* Niagara division of the Upper Silurian, at Bridgeport, near Chicago, Illinois. Prof. Hall's typical specimens of *A. acutirostris* were from the same horizon near Milwaukee, Wisconsin, though he says he has seen a specimen from Bridgeport he believed to be the same.

## Genus AMPHICŒLIA, Hall, 1864.

*Amphicœlia*, Hall, 1864. Supp. to Eighteenth Report Regents Univ. N. Y., p. 85.

This group was indicated by Prof. Hall (with doubt) as subgenus under *Leptodomus*, McCoy, as follows: "The general form of the shell is subrhomboidal, with elevated beaks. The casts present the appearance of a large triangular cartilage pit beneath the beaks; and just anterior to this, and separated by a thin process on each valve, is an apparent second pit; or the whole may be a large cartilage pit divided by a thin septura. No teeth have been discovered on the extension of the hinge line. The muscular impressions are faint and the shell thin."

Having had an opportunity to examine numerous examples of the type of this group, from the original locality, we fully concur with Prof. Winchell and Prof. Marcy* in the opinion, which had been for some time entertained by us, that it is entirely distinct from *Leptodomus*, either as originally defined and illustrated by Prof. McCoy, or as subsequently extended by that author.†

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* Enumeration Foss. Nig. Li. at Chic., Mem. Bost. Soc. Nat. Hist., Vol. I, No. 1, p. 108.

† We expressed this opinion in the 2d vol., p. 339. Prof. Hall has since adopted the conclusion that this type has no near relations to *Leptodomus*. (See Regents' Report, 1868 (for 1867), p. 387.

The type of *Amphicœlia*, however, is widely removed from all of these shells by its broad, flat, longitudinally striated cardinal plate, like that of *Pterinea* and *Myalina*, and cavity at the anterior extremity of the hinge as we often see in the latter genus. In short it belongs to the *Aviculidæ*, near *Pterinea*, and *Ambonychia*. It differs from both of these groups generically, however, in wanting their hinge teeth, as well as from the former in wanting the well developed, deep, anterior muscular impression.

So far as we have been able to see, from the examination of numerous specimens, the pit or cavity between the beaks is not double, or divided by a septum, as suggested by Prof. Hall. It is a simple cavity, located at the obtusely angular intersection of the somewhat thickened anterior margin, and the anterior extremity of the hinge is very similar to that seen in some species of *Myalina*. Specimens in the possession of Prof. Marcy show that there was no distinct byssal opening in front, at least in adult shells, while the valves appear to fit closely all around.

The almost, if not quite, equivalve character of this shell might be supposed to throw doubts upon the suggestion that it belongs to the *Aviculidæ*. The fact, however, that its broad, striated cardinal area inclines more or less over to the right, in both valves, indicates a want of exact symmetry of the two valves not at all apparent in the internal cast, and much as we often see in *Myalina*, and other types of that family.

## AMPHICŒLIA NEGLECTA, McChesney.

Pl. 5, fig. 9 a, b, (not c).

*Ambonychia neglecta*, McChesney, 1861. New species Palæozoic Fossils, p. 88.
*Amphicœlia Leidyi*, Hall, 1865. Supp. to Eighteenth Report Regents Univ. N. Y., p. 35.
*Pterinea* (*Amb.*) *neglecta*, McChesney, 1865. Expl. pl. 9, Illustrations Palæozoic Fossils.
*Pterinea neglecta*, Winchell and Marcy, 1865. Mem. Boston Soc. Nat. Hist., vol. I, p. 96.
*Amphicœlia neglecta*, McChesney, 1868. Trans. Ohio. Acad. Sci., vol. I, p. 41, pl. 9, fig. 2.

SHELL nearly or quite equivalve, subquadrate, suborbicular, or somewhat longer than high, rather gibbous in the umbonal and anterior regions, and more compressed and subalate posterodorsally; hinge line straight, less than the greatest length of the shell; cardinal area wide—its longitudinal striæ rather fine; posterior margin subtruncate, at a more or less obtuse angle with the hinge above, and rounding regularly into the base below, which forms a regular semicircular curve; anterior side very short, and rounding from below the beaks into the base; beaks prominent, gibbous, incurved, and placed about one-fourth the entire length of the valves behind the most prominent part of the anterior margin. Surface marked by fine, regular, rather flattened, radiating striæ. Posterior muscular impression rather large, shallow, oval, and placed about half way between the middle and the posterior margin, and above the middle of the valves; pallial line extending around from the posterior muscular scar, and up the front towards the beaks. (No anterior muscular scar yet seen.)

Length of a large internal cast, 2.57 inches; height of do. to cardinal ridge (exclusive of the area), 2.08 inches; convexity, 1.50 inches.

*Locality and position:* This fossil is common, in the condition of internal casts, at the quarries in the Niagara limestone at Bridgeport, near Chicago, Illinois. Prof. Hall also gives Racine and Wauwatosa, Wisconsin (same position), as other localities where it occurs. At Bridgeport it is nearly always in the condition of internal casts, and even these are rarely found entire. It is occasionally found, however, in the condition of external casts, showing portions of the striated outer surface preserved.

## GASTEROPODA.

### GENUS PLEUROTOMARIA, Defrance, 1824.

(Dict. Sci., Nat. Atl. Pl. Foss., 86.)

### PLEUROTOMARIA CASII, M. and W.

Pl. 5, fig. 5.

SHELL attaining a rather large size, higher than wide; spire conical, a little more than equaling the length of the lower half of the body volution. Whorls about five and a half—very convex; those of the spire each showing three-fourths of its entire height above the next succeeding one; upper ones (in casts) rounded; last one large and ventricose, and, like the next above, subangular around near the middle, below which it is somewhat produced, and rounds into a small umbilical opening in the cast, probably entirely closed by the columella in specimens retaining the shell. Spiral band apparently of moderate breadth, occupying the obtuse angle a little above the middle of the body whorl, and passing around near the middle of the others. Suture deep, in consequence of the convexity of the volutions. Aperture subcircular. Surface of internal casts showing, on the upper convex slope of the body whorl, and that of the next above it, obscure transverse ridges, curving backwards as they extend out from the suture, probably parallel to the lines of growth. Crossing these, there is an undefined revolving ridge (represented too prominently in the figure) on the body whorl, a little more than half way out from the suture towards the spiral band. (Other surface markings unknown.)

Height, 2.14 inches; breadth, about 1.85 inches. Slope of spire nearly straight; divergence, about 75°.

This fine species will be readily distinguished from any Silurian form known to us, resembling it in other respects, by the transverse ridges of the upper side of its body whorls. It doubtless had other distinguishing finer sculpturing not seen on the cast. In size and form, it seems to have presented some general resemblance to *Murchisonia vitellia*, Billings (New Lower Sil. Foss., June, 1862, p. 155, fig. 138), but differs in having more rounded whorls and the transverse ridges, and obscure revolving ridge of the upper side of the volutions.

*Locality and position:* Niagara division of the Upper Silurian; Bridgeport, near Chicago, Illinois.

### PLEUROTOMARIA CYCLONEMOIDES, M. and W.

Pl. 5, fig. 4.

SHELL conoid-subglobose, nearly as wide as high; volutions about four and a half, increasing rather rapidly in size, all rounded, last one ventricose, and regularly rounded from the suture above into the small umbilical pit below, which in internal casts is a small perforation, probably closed by the columella in testifirous specimens; suture well defined in consequence of the convexity of the whorls; aperture nearly circular. Surface ornamented by rather large revolving lines (generally well defined on internal casts), two of which, just above the middle of the body volution, and at the middle of those of the spire, are a little larger than the others, and include the spiral band between them; crossing all of these are seen, on well preserved specimens, smaller and more closely arranged transverse striæ, giving the surface a cancellated style of ornamentation.

Height, 0.86 inch; breadth, 0.81 inch; spire with slightly convex slopes; divergence, about 83°.

In general appearance the casts of this shell are not unlike a form figured by Prof. Hall in the Twentieth Report of the Regents Univ., N. Y., on State Cab. Nat. H., pl. 15, fig. 9, under the name *Trochonema* (*Pleurotomaria*) *pauper;* but our species will be readily distinguished by its much more numerous revolving ridges.

*Locality and position:* Niagara division of the Upper Silurian; at Bridgeport, near Chicago, Illinois, where it is found in the condition of internal casts. Our figure is defective in not showing indications of two other revolving lines above those represented on the body volution, and several smaller ones on the next turn. Its body volutions should also be represented as a little more produced below at the aperture.

## GENUS SUBULITES (Conrad), Emmons, 1842.

(In EMMONS' Geol. Report N. Y., p. 392.)

WE have elsewhere alluded to the close relations between this genus and *Polyphemopsis*, of Portlock, founded upon the Carboniferous species, *P. elongata*, Portlock, and *P. fusiformis*, Sowerby, sp. This close resemblance is more obvious, on comparison of species like that described below, with Portlock's types, than in comparing the latter with the typical forms of *Subulites*. It is possible that the base of the aperture of the Lower Silurian, *S. elongatus*, of Conrad (the type of *Subulites*), may, when entire, present some differences from that of the Carboniferous shells upon which *Polyphemopsis* was founded, as it seems to have the columella straighter, and the aperture drawn out as if it terminated in an effuse extension resembling a short canal. In case such a difference exists, however, and is of generic or subgeneric importance, the species described below would certainly fall into the group *Polyphemopsis*, as good specimens show that it has exactly the same form of aperture, with the same curved base of its columella and oblique curve of the lower part of its body whorl, seen in the typical *Polyphemopsis fusiformis*, from which its only essential specific differences consist in having rather more convex and not quite so many volutions.*

The twisting or bending of the body whorl, is very marked in the species described below, and supports the suggestion made by us some time since, that these shells probably belong to the *Eulimidæ*, in which this irregularity of form is not uncommon.

In case it should be determined that *Subulites* and *Polyphemopsis* are not generically distinct, a question will arise in regard to which name should take precedence. Conrad's manuscript name was published, and a species figured (without a generic description) by Dr. Emmons, in 1842, and again by Dr. Owen, in the same way, in 1844; and the genus was not described until Hall published a diagnosis in 1847; while Portlock's name, *Polyphemopsis*, was published in 1843. Those who maintain that a genus can not be established without a description, would be compelled to adopt *Polyphemopsis*, and those who maintain that the publication of a name, with a figure of an example, is sufficient to establish a genus, would adopt *Subulites*.

## SUBULITES (POLYPHEMOPSIS) BREVIS, W. and M.

Pl. 5, fig. 6.

*Subulites brevis*, WINCHELL and MARCY, 1865. Mem. Boston Soc. Nat. Hist., vol. I, p. 100, pl. 2, fig. 9.

? *Subulites ventricosus*, HALL, 1852. Palæont. N. Y., vol. II, p. 347, pl. 83, fig. 7 *a*, *b*.

*Subulites ventricosus*, HALL, 1865. Extract Eighteenth Report Regents University N. Y., p. 42; Twentieth do., pl. 15, fig. 1.

SHELL subfusiform, always more or less bent to one side at the suture between the spire and body volution; aperture and spire of nearly equal length; volutions about six, a little convex, last one rather ventricose; suture shallow; aperture narrow, obliquely sub-ovate, effuse below; and angular above. Columella with the oblique curvature and basal truncation of the genus strongly marked. (Surface unknown.)

Length, 1.50 inches; breadth of body whorl, about 0.65 inch.

We are not quite sure this is the shell figured and described by Prof. Winchell and Prof. Marcy, as it seems to be rather more ventricose. As it agrees, however, more nearly with their figure and description than any other form known to us from that locality, and their specimen was very imperfect, it may belong to the same species. It is probably identical with *S. ventricosus*, Hall, though our specimens seem to be more ventricose, and, as noticed by Professors Winchell and Marcy, more bent.

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* It is an interesting fact, worthy of note in this connection, that there is a little shell found in the St. Cassian beds of Austria, described by Munster, under the name of *Melania fusiformis*, and recently made the type of a new genus *Euchrysalis*, by Laube (see Fauna der St. Cassian, part III, p. 42, 1868), that seems remarkably similar, excepting in its smaller size, to *Subulites elongatus*, of Conrad.

Our figure of this shell is unfortunately not accurate in all respects, as it makes the second volution too convex on the left side, and shows only very indistinctly the suture between the body volution and the next one above. A part of the lip of the body whorl, on the left side, is also hidden in the matrix.

*Locality and position:* Bridgeport, near Chicago, Illinois. Niagara division of Upper Silurian.

# ARTICULATA.

## *CRUSTACEA.*

### GENUS DALMANITES, Auct.

### DALMANITES DANÆ, M. and W.

Pl. 6, fig. 1 *a, b, c, d, e, f.*

*Dalmania Danæ*, MEEK and WORTHEN, Dec., 1865. Proc. Acad. Nat. Sci., Philad., p. 264.

ATTAINING a large size, entire outline ovate. Cephalic shield rather compressed, nearly semicircular, about twice as wide as long, rounded in front, and nearly straight or slightly concave in outline behind, with posterior lateral angles produced into mucronate spines extending backwards to the fourth or fifth thoracic segment. Glabella composing rather more than one-third the entire area of the shield, and slightly more convex than the cheeks, including the neck segment, as long as its greatest anterior breadth, and about twice as wide (exclusive of the alæ, or fixed cheeks) in front as behind; separated from the cheeks on each side by a well defined furrow; anterior lobe composing about half its entire area, transversely elliptical, and a little less than twice as wide as long, usually showing, in internal casts, a shallow pit near the middle of its posterior side; lateral furrows well defined—anterior one oblique, the other two transverse, and not always strongly defined quite out to the lateral margins; anterior lateral lobe longer, more oblique, and, at its outer end, wider than either of the other two. Occipital segment widest and most prominent in the middle, scarcely equaling the transverse diameter of the posterior extremity of the glabella; neck furrow well defined, but deepest on each side, and arching a little forward in the middle; its continuations across the posterior sides of the cheeks broad, deep, and straighter than the posterior margin—extending nearly to the lateral margins of the cheeks, where they curve a little backwards. Cheeks sloping slightly around the outer side to a broad, shallow, undefined marginal depression, outside of which there is a moderately thick, somewhat rounded border, which does not extend entirely around the front of the glabella, but continues back into the posterior lateral spines. Eyes reniform, not oblique, nearly half as long as the antero-posterior diameter of the front lobe of the glabella, and situated slightly more than their own length in advance of the posterior margin of the cheeks, with (in casts) a moderately distinct marginal furrow around their outer bases; (height and other details unknown); palpebral lobes semicircular and depressed. Facial sutures cutting the lateral margins of the cheeks nearly opposite the posterior extremities of the eyes, and passing around the antero-lateral and front margins of the glabella so near the anterior border as scarcely to leave any perceptible band connecting the movable cheeks around the front.

Hypostoma obscurely subtrigonal, about one-eighth wider anteriorly than its length, moderately convex; anterior margin forming a broad, regular, convex curve; lateral margins contracted behind the anterior lateral angles, and converging a little posteriorly for about two-thirds the entire length, thence more abrubtly to the posterior extremity, which is transversely truncated, and provided on each side with a minute, slightly projecting point, while still farther forward, on each lateral margin, there appears to be traces of another minute slightly projecting irregularity of outline. Around the posterior and lateral margins there is a more or less distinct sulcus, behind which the posterior margin is flattened. Within this marginal sulcus there is, on each side, a little behind the middle, an oblique eye-like depression.

Thorax wider than long, the length being to the breadth as 21 to 28, nearly once and a half as long as the cephalic shield; mesial lobe as wide anteriorly as the posterior extremity of the glabella, and very slightly broader near the middle, where it is about three-fourths as wide as the lateral lobes, from which it is only separated by narrow, rather shallow furrows—most convex along the middle and flattened on each side; segments not clearly seen in the specimens examined. Lateral lobes somewhat more depressed than the mesial one, and sloping very gradually to the lateral margins. Segments equaling the antero-posterior diameter of the posterior lateral lobes of the glabella; each curving abruptly backwards at the outer extremity, and terminating in a flat, sharply pointed, or lanceolate projection, most produced in the posterior ones; provided with a deep, well defined, longitudinal furrow, which starts from the anterior side of the inner end, and curves at first a little obliquely outward, and then passes straight outward, slightly nearer the posterior than the anterior margin, to the middle of the flattened scythe-shaped outer ends, where they usually curve a little backwards and become obsolete.

Pygidium nearly semielliptic, or subtrigonal, the anterior lateral angles being somewhat rounded, and the lateral margins converging to the more or less pointed posterior extremity, with a broad convex curve; slightly longer than the cephalic shield, and rather more than two-thirds as wide; mesial lobe somewhat more convex than the lateral lobes, and two-thirds as wide, gently rounded, and tapering gradually to the posterior extremity, where it is apparently continued into an abruptly projecting caudal appendage; segments 12 to 13, straight, well defined (excepting near the termination) by distinct furrows, which are deeper on each side than at the middle. Lateral lobes with eight or nine well defined arched segments, which become more oblique posteriorly, and are defined to near the edge of the smooth margin; each divided by a furrow deeper than those between, and like in those of the pleuræ, the anterior division being slightly narrower than the other at the inner end.

Surface (of cast) smooth, excepting traces of small, scattering tubercles on the anterior lobe of the glabella.

Length of the largest specimen seen, exclusive of the little caudal appendage (the length of which is unknown), 4.93 inches. Length of pygidium, 1.50 inches; breadth of same, 2 inches; breadth of its axillary lobe, 0.55 inch. Length of thorax, 2.05 inches; breadth of same, 3 inches; breadth of its mesial lobe, 0.80 inch. Length of cephalic shield, 1.44 inches; breadth of same, 3 inches; length of posterior lateral spines, near 1.10 inches; length of glabella, exclusive of neck segment, 1.30 inches; anterior breadth of same, 1.35 inches; posterior breadth of same, 0.84 inch. Length of eyes, 0.39 inch; distance of same from posterior margin of cheeks, 0.42 inch.

Named in honor of Prof. James D. Dana, of New Haven.

We have described this fine species in as much detail as possible, because it is somewhat nearly allied to several of the already described species. Perhaps it is most nearly allied to the well known European *D. caudatus* of Brunnich, with which it agrees in size, form, and many of its details. In the first place, it differs, however, from that species in having the anterior margin of its cephalic shield decidedly more rounded than even the variety or form regarded by Mr. Salter as the female, while it shows no marginal rim (as seen from above) extending around the front of the glabella. Again, the eyes, instead of being placed about *half* their own length in advance of the posterior margin of the buckler, are rather more than their *entire* length from the posterior margin. The produced spine-like appendages of its cheeks are also, in all our specimens, uniformly distinctly smaller, and only extend back a little beyond the termination of the fourth thoracic segment, instead of to the sixth, as in *D. caudatus*. On comparing the hypostoma of our species with Mr. Salter's excellent figures of that of Brunnich's species, it is found to present marked and decided differences, as may be seen by a glance at our figure. In the ribs of the thorax we also observe differences, those of our species being more distinctly deflected backwards, and more sharply produced at their outer extremities, particularly the posterior ones. The differences in the pygidium are likewise well defined, its lateral margins forming almost a regular convex arch from the antero-lateral angles to the caudal projection (which seems to be shorter, and much narrower than *D. caudatus*), instead of being nearly straight, or even concave, in outline, posteriorly.

Most of these differences we have ascertained from a careful study of a good series of specimens, to be constant in our species, so that they can be relied upon as not being individual or sexual peculiarities.

In some respects this species is probably even more nearly allied to the common American *D. limulurus*, while in others it differs more widely. In size it far exceeds the largest examples of *D. limulurus* we have ever seen, while all our specimens show the difference in the obtusely rounded anterior extremity of the head, and the absence of a marginal rim around the middle of the front to be constant. The convex outline of the lateral margins of its pygidium, already mentioned, also contrasts strongly with that of *D. limulurus*, and even the largest specimens of our species, five inches in length, only show twelve to thirteen segments in the mesial lobe, instead of fifteen, as in the New York species. The caudal appendage, if produced at all, must also be much narrower at its origin in our species.

The greater number of segments in the mesial and lateral lobes of the pygidium, and the distinct granular surface of both *D. pleuroptyx* and *D. micrurus*, will alone serve to distinguish them from the species under consideration; while the hypostoma of *D. micrurus*, at least, is entirely different.

In first publishing this species, we suggested that if the name *Dalmania* could not be retained for this genus, in consequence of its having been previously used for a genus of *Diptera*, that Hawle and Corda's name *Odontocheile* (1847) would probably have to be adopted for it. We have, however, since been informed, by good authority in Entomology, that the name *Odontocheile* was also previously used in 1834 for a good genus of *Coleoptera*. Consequently we have adopted the sufficiently distinct name *Dalmanites*, first used, we believe, by Prof. Barrande.

*Locality and position:* Two miles above Thebes, Alexander county, Illinois. Apparently at near the horizon of the Niagara division of the Upper Silurian.

# FOSSILS OF THE LOWER HELDERBERG GROUP.

## (SHALY LIMESTONE.)

# RADIATA.

## ZOOPHYTA.

### GENUS STRIATOPORA, Hall, 1852.

*Striatopora*, HALL, 1852. Palæont. N. Y., vol. II, p. 156, pl. xl, B; Iowa Report (1858), p. 479.

WE are very much inclined to think that the name *Cyathopora*, used by Dr. Owen in 1844, in connection with a species of this genus, will have to be adopted for it. The only reason for doubting the propriety of retaining this name is, that he merely gives a very brief description, *without saying* whether he intended it as a description of the typical species, or of the genus, or for both together, as is not unfrequently done. He merely speaks of it as "a new coralline," and describes it as follows:

"*Cyathopora Irwensis*, (see plate No. 11, after page 72*)—twig-like, single or branching; cellular. Cells diverging from the axis to the circumference, and opening on the surface in distinct cup-shaped mouths, with an elevated margin, one inch and one-half long, one-seventh of an inch in diameter." (Report Geol. Expl. Iowa, Wisconsin and Illinois, p. 69, 1844.)

The fact that he has the name of this fossil in the index of his larger Report on the Survey of Wisconsin, Iowa and Minnesota (published in 1852), printed *Cyathophora Iowensis*, might seem to indicate that he had from the first only intended to refer the new species to the genus *Cyathophora* of Michelin. Yet he always calls it *Cyathopora* in the first of the above mentioned Reports, and even at the only place he mentions it in the body of the latter work, he writes it *Cyathopora*, and only has it *Cyathophora* in the index, where it may be an accidental error. The fact that he alludes to it in both his Reports as "a new coralline," while he makes no such allusion to any of his other new *species*, would favor the conclusion that he regarded it as a new *genus*. The strongest reason for the latter conclusion, however, is the wide dissimilarity of the coral he was describing to *Cyathophora* of Michelin, which is an aggregated, massive Stylina-like coral, widely different from his little branching "twig-like" fossil. It therefore seems exceedingly improbable that Dr. Owen could have intended to refer his species to such a genus as *Cyathophora*, and as there was no established genus *Cyathopora*, it would appear to be very probable that he intended to establish such a genus when he wrote his description.

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* This reference is made by Dr. O. to his own figure.

Until such questions in nomenclature can be settled by the establishment of some more fixed rules than prevail at present, we merely retain the name *Striatopora* provisionally, without intending to express a positive opinion respecting its claims to precedence.

In regard to the generic identity of the coral described by Dr. Owen, with that upon which the genus *Striatopora* was founded, there can be no doubt. Indeed Prof. Hall has since described and figured Dr. Owen's typical species, *C. Iowensis*, under the name *Striatopora rugosa*. (See Iowa Report, vol. 1, part II, p. 479, pl. 1, fig. 6, 1858.) If the generic name *Striatopora* is to be retained, the name of the Iowa species will of course become *Striatopora Iowensis*.

## STRIATOPORA MISSOURIENSIS.

Pl. 7, fig. 4.

CORALLUM slender, ramose; branches cylindrical; cells obliquely ascending from an imaginary axis, rather distantly separated, slender and rounded within, but enlarging and curving outwards to the surface, where they terminate in comparatively large, transversely oval, or subrhombic mouths, alternately arranged, and directed more or less obliquely upwards, with a sharp, rather prominent lip below; striæ distinct, ascending from each cell, and continued up the upper side of the enlarged opening, to the lower margins of the succeeding openings above.

Length unknown; diameter of an imperfect branch, about 0.20 inch.

This specie is perhaps most nearly allied to *S. flexuosa*, Hall, from the Niagara group of New York, but has its cell mouths very differently formed, being generally transversely rhombic in form, and opening more obliquely upwards. Their striæ are also more distinct. It is much less robust than the Hamilton group species *Iowensis* of Owen (=*rugosa*, Hall), which has stouter branches, with more rounded cell mouths, not nearly so distinctly striated within. Its cells are much less crowded, and have less round and more strongly striated openings than *S. Linnæana* of Billings.

Should Dr. Owen's name *Cyathopora* be retained for this genus, the name of our species will have to be written *C. Missouriensis*.

We regret that the engraver was not very successful in representing this fossil in the figure given on plate 7.

*Locality and position:* Bailey's Landing, Perry county, Missouri; in a limestone of the age of the "Shaly limestone" of the New York Lower Helderberg division of the Upper Silurian.

# ECHINODERMATA.

## GENUS EDRIOCRINUS, Hall, 1859.

(Palæont.,N. Y., vol. III, p. 119.)

### EDRIOCRINUS POCILLIFORMIS, Hall.

Pl. 7, fig. 5 *a*, *b*.

*Edriocrinus pocilliformis*, HALL, 1859. Palæont. N. Y., vol. III, p. 121, pl. v, fig. 8-12.

BODY, below the summit of the first radial pieces, obconical; base slightly wider than high, rounded below, and a little oblique, faintly scalloped above, for the reception of the succeeding range of plates. First radial pieces slightly longer than the base, oblong (being longer than wide), and each distinctly sinuous and transversely grooved above, for the reception of the second radials; second radial pieces, and other parts above, unknown. First anal piece slightly narrower than the first radial pieces, and of the same form and length, but truncated instead of sinuous above; second anal piece of the same breadth as the first, and resting upon the upper truncated edge of the latter; its length unknown. Surface smooth, or finely granular.

Length, to summit of first radial pieces, 0.45 inch; breadth, to top of do., 0.35 inch.

We have, of course, exceedingly few, and little marked characters, to guide us in identifying this species with *E. pocilliformis*, which is only known from its detached little base. So far as can be determined, however, our specimen agrees exactly in this part.

It is an interesting fact, that this remarkable genus should have been represented so long after, by so nearly allied a type as the genus *Cotylederma*, of Quenstedt, from the Jurassic rocks. It seems to differ from *Cotylederma* only in having an anal piece on the same range with the first radials, the relations between the two groups being exactly the same as between *Hexacrinus* and *Platycrinus*.

*Locality and position:* Same as last.

# MOLLUSCA.

## BRACHIOPODA.

### GENUS ORTHIS, Dalman, 1828.

(Uppstalln. p. 110.)

### ORTHIS HYBRIDA, Sowerby?

Pl. 7, fig. 7 *a*, *b*, *c*, *d*.

*Orthis hybrida*, SOWERBY, 1839. Murchison's Silurian System, p. 630, pl. 13, fig. 11; HALL, (1843), Geol. Report 4th Dist. N. Y., p. 107, fig. 7; Palæont. N. Y., (1852), Vol. II, p. 253, pl. lii, fig. 4 *a–a*.

Compare *O. oblata*. HALL, 1857. Report Regents Univ. N. Y., on State Cab. N. H., for 1856, p. 41; Palæont. N. Y., vol. III, pl. x, fig. 1–22.

SHELL rather small, resupinate, nearly equivalve, compressed or moderately convex, suborbicular, the breadth being to the length about as 50 to 45; lateral margins rounded; front more broadly rounded, or nearly straight along the middle; hinge line very short, and not imparting any angularity to the posterior lateral outline. Dorsal valve moderately convex, with sometimes a very faint depression along the middle, toward the beak*; beak extending a little beyond the hinge, and slightly arched. Ventral valve flattened anteriorly, but more convex in the umbonal region; beak scarcely projecting beyond that of the other valve, arched but not strongly incurved; area very small; foramen comparatively rather large. Surface ornamented by numerous fine, bifurcating striæ, which, on the posterior lateral regions of the valves, curve gracefully outward. A few concentric marks of growth are also sometimes seen.

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* The shading on fig. 7 *a* makes this depression appear too distinct.

Length of a specimen somewhat less than the largest, 0.37 inch; breadth, 0.40 inch; convexity, 0.17 inch.

Although this shell occurs in the same horizon as *O. oblata*, of Hall, from which it can scarcely be distinguished, excepting by its smaller size, and *O. hybrida* has not, we believe, been identified in this country as high in the series as this occurs, we are completely at a loss to see how our shell can be distinguished from the latter in any way. It is much smaller than large adult specimens of *O. oblata*, and proportionally less transverse; but on placing it by the side of a young individual of that shell, of its own size, they are seen to be so exceeding similar in form and almost every respect, that we doubt whether any one would ever suspect them to be distinct, if they occurred together. Yet, on a close inspection, the striæ on the shell under consideration are seen to be very slightly finer than on a young individual of *O. oblata* of its own size. That is, in a specimen of our shell of the size we have figured, seven to eight striæ may be counted in the space of one-tenth of an inch at the margin, while six to seven occupy the same space on the margin of *O. oblata*. As slight as this difference is, it is perceptible to the unassisted eye, when attention is directed to it.

On comparison with *O. hybrida*, however, our shell is seen to agree, not only in size and form, but even in this slightly finer character of striæ. Consequently, unless it may possibly present some internal differences, it would certainly puzzle any one to point out any appreciable distinction.

It may, we think, be fairly questioned whether or not the larger size, and other slight differences, on which *O. oblata* has been separated from *O. hybrida*, may not be due to a more robust development, produced by more favorable local conditions, than to any valid specific distinctions.

*Locality and position*: Same as last.

## ORTHIS SUBCARINATA, Hall.

Pl. 7, fig. 6 *a*, *b*, *c*, *d*.

*Orthis subcrinata*, HALL, 1857. Ann. Report Regents Univ. N. Y. for 1856, p. 48; Extr. from same (1857), p. 8; Palæont. N. Y., vol. III (1859), p. 169, pl. xii, fig. 7-21.

SHELL quadrato-subcircular, or transversely suboval, moderately convex; lateral margins more or less round; front forming a semicircular curve, or somewhat straightened, or even slightly sinuous in the middle; hinge margin less than the breadth of the valves, sometimes, though rarely, imparting an obtusely subangular outline to the posterior lateral margins. Dorsal valve depressed, convex near the beak, flattened around the anterior lateral margins, and concave along the middle, the concavity commencing very narrow at the beak, and rapidly widening, and becoming less defined towards the front; beak projecting little beyond the hinge, and somewhat curved. Ventral valve rather distinctly more convex than the other, particularly along the middle, where it rises into a rounded ridge, most prominent at the umbo, and soon dying out anteriorly, while the lateral slopes from this ridge are straight, or sometimes, near the umbo, a little concave in outline; beak smaller, but little more prominent than that of the other valve, and not very strongly incurved; area narrow, and becoming sublinear towards the lateral extremities of the hinge. Surface ornamented by numerous fine radiating striæ, increasing in number mainly by intercalation, and on the lateral and posterior lateral regions, curving gracefully outwards.* Subimbricating concentric marks of growth are also usually more or less distinctly defined at intervals.

Length of the largest specimen seen, 0.52 inch; breadth, 0.60 inch; convexity, 0.29 inch.

This species has much the appearance of *O. testudinaria*, of the Lower Silurian, but attains a much larger size, and has distinctly finer and less fasciculated radiating striæ, scarcely marked by concentric striæ; while it is likewise distinguished by internal differences. It also differs from *O. elegantula*, of the Upper Silurian, in having its dorsal valve more convex, and its ventral one less so, with a less prominent and incurved beak, and a narrower area; while there are also, as shown by New York specimens, internal differences.

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* They are represented rather too straight in the figures, particularly on the sides of figure 6 *d*.

It is most nearly allied to its (in New York) associate forms, *O. planoconvexa* and *O. perelegans*, of Hall, but differs from them both in its internal characters, while it is a more convex species than the first, and less so than the second.

We know nothing of the interior of our specimens, and as we have seen but two complete individuals, the identification is not made with entire confidence, though we have not much doubt as to their identity. The individual we have figured has a rather distinctly more quadrangular form than is usual amongst the New York examples of *O. subcarinata*, and a straighter cardinal outline, but not more so, nor even as much, as one of the individuals of that species figured on plate 12 of the Third Vol. Palæontology of New York; while our other specimen agrees more nearly in this respect with the usual forms of *O. subcarinata*.

From the form we have referred to *O. hybrida*, the shell under consideration will be at once distinguished by its subcarinate *ventral* valve, and compressed *dorsal* one; the *dorsal* valve in *O. hybrida* being the more convex, and the *ventral* the more compressed at the front.

*Locality and position:* Same as last.

## GENUS STROPHOMENA, Raf., 1820.

(*Strophomenes*, Raf.—*Strophomena*, Blainv. (1825), Malac., p. 513.)

### STROPHOMENA (STROPHODONTA) CAVUMBONA, Hall?

Pl. 7, fig. 10 *a*, *b*.

*Strophodonta cavumbona*, HALL, 1857. Report Regents Univ. N. Y. for 1856, p. 51; Palæont. N. Y., vol. III (1859), p. 187, pl. xxi, fig. 1—3.

SHELL semioval, length about five-sixth the breadth; hinge margin equaling the greatest breadth, with the crenulations fine and oblique; posterior lateral extremities nearly or quite rectangular; lateral margins straight, and parallel posteriorly, or sometimes very faintly sinuous near the extremities of the hinge, and rounding to the front, which forms a regular semicircular curve. Dorsal valve more or less distinctly concave at the umbo, and forward to the middle, and flattened on each side behind, but quite convex around between the middle and the anterior lateral margins, which curve distinctly downwards;

beak not projecting beyond the hinge; interior showing scarcely any traces of the muscular scars, but rather distinctly striated, marked with small scattering granules. Surface ornamented by rather distinct, bifurcating, radiating striæ, but little curved on the lateral regions. Ventral valve unknown.

Length, 0.85 inch; breadth, 1.03 inches; convexity, 0.28 inch.

This shell seems to agree in most of its characters with *S. cavumbona*, excepting in being distinctly longer in proportion to its breadth, and in having lateral margins straighter, and its posterior lateral angles not so pointed. None of our specimens have the surface well enough preserved to show the fine concentric lines on the striæ, if they existed.

The specimen from which figure 10 *b* was drawn, is deeply concave, excepting in the umbonal region (which is convex, but made too much like an *angular* ridge in the figure); and owing to the distinctness of its striæ, it was some time before we could be fully satisfied that it is not the *outside* of the ventral valve of a strongly resupinate species. A careful examination, however, shows that it has the granulated character of the internal surface of such shells; while an examination of its hinge line, under a magnifier, shows the remains of the crenulations. On examining the convex cast in the matrix, represented by figure 10 *a*, from this concave specimen, we find that although showing the impressions of the striæ, and scattering granules quite distinctly, it exhibits scarcely a trace of muscular scars, which latter fact would also seem to indicate that it is rather a cast of the outside than of the inside of the valve; but on removing some small fragments of the shell about the beak, unmistakable evidences of the remains of the biparlite cardinal process were seen penetrating the matrix, which leave no room to doubt that the specimen 10 *b* shows the interior of a dorsal valve, from which the cardinal process and some of the inner laminæ have been removed in breaking open the rock, and carried with the cast. This partial exfoliation would, to some extent, account for the distinctness of the striæ, and absence of muscular scars within. This, however, was evidently a characteristic of the interior, as shown in the cast represented by figure 10 *a*.* Two other casts of the interior of the same valve are also very distinctly striated, while one of them shows traces of the muscular scars.

Although we have referred this shell provisionally to *S. cavumbona*, we are very much inclined to believe, from its greater proportional length, and straight sides, with less angular cardinal extremities, that it will be found to be specifically distinct; if so, it may be called *S. rectilateraria*.

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* This figure is not made to look convex enough in front of the middle.

*Locality and position:* Bailey's Landing, Perry county, Missouri; from a limestone of the age of the Delthyris shaly limestone of the New York Upper Silurian series.

## GENUS MERISTA, Suess, 1851.

### MERISTA LÆVIS, Vanuxem? (sp.)

Pl. 7, fig. 8 *a*, *b*, *c*.

*Atrypa lævis*, VANUXEM, 1843. Report Third Geol. Dist. N. Y., p. 120, fig. 2; HALL (1857), Ann. Report Regents University of N. Y. for 1856, p. 94; Palæont. N. Y., vol. III (1859), p 247, pl. 39.

SHELL ovate, rather ventricose, breadth about three-fourths to five-sixths the length, greatest breadth generally in front of the middle. Dorsal valve moderately convex, more or less arched from the beak to near the front (which is usually a little raised in the middle), and sloping to the anterior lateral margins, which, in the wider specimens, are somewhat flattened; beak rather pointed and incurved. Ventral valve more convex than the other in the umbonal region, forming a regular arch from the beak to the front, which is a little produced and impressed in the middle, to correspond to the raised front of the other valve; a faint, very narrow mesial sinus also continues backward to near the middle of the valve; beak rather pointed and strongly curved over, and upon that of the other valve.* Surface with obscure concentric lines, and at intervals stronger marks of growth, and faint traces of obscure radiating striæ, most distinctly seen upon exfoliated surfaces and internal casts.

Length of largest specimen seen, 0.88 inch; breadth, 0.77 inch; convexity, 0.45 inch.

The identification of species in a genus like this, from a few imperfect specimens, showing none of the internal characters, can, of course, only be regarded as provisional. Indeed, it is even possible that specimens showing the interior of our shell, might prove it to belong to a distinct genus from *M. lævis*. The specimen we have figured, although in most respects the best we have seen, is made to present an unnatural narrow appearance, in consequence of the anterior lateral margins being broken away; other specimens, however, having these margins entire, are proportionally wider anteriorly, and seem to agree nearly in outline with specimens of the New York shell of the same size. A defect in the engraving also makes the concentric ridges of growth much too obscure on figure 8 *c*, and the radiating striæ too distinct, and defined near the beak, where they are obsolete. The faint mesial sinus in figure 8 *b*, is likewise made too broad.

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* In the specimen there appears to be a round perforation in the end of the beak, but as it is not seen in other specimens, we believe it to be due to an accidental break, and have not had it represented in the figure, but thought it proper to mention the fact. Of course, if it is a natural perforation, the shell is not a *Merista*.

None of our specimens are near so large as the larger individuals of the New York shell. It is worthy of note, however, that nearly all the forms, either identical with, or representing New York species, found at this western locality, are somewhat smaller than their representatives in the east.

*Locality and position:* Same as the last.

## GENUS ZYGOSPIRA, Hall, 1862.

*Stenocisma*, HALL, 1857. Palæont. N. Y., vol. I, p. 142; MEEK, Palæont. Upper Mo., 1864, p. 16; (not CONRAD, 1839.)
*Zygospira*, HALL, 1862. Fifteenth Ann. State Cab. Report Regents Univ. N. Y., p. 154.
*Cœlospira*, HALL, 1863. Sixteenth do., appendix D., p. 60.
Compare *Anoplotheca*, SANDBERGER, 1856. Sitzungsb. Kais. Akad. Wiss. XVIII, p. 104.

It seems to us doubtful whether these little shells should be separated more than subgenerically from *Atrypa*. If distinct from that group, however, it is highly probable that Sandberger's older name, *Anoplotheca*, will have to be retained for the group. Sandberger's type (his *A. lamellosa*) is a very similar little shell, in form and general appearance, to those for which the names *Zygospira* and *Cœlospira* were proposed, and it also has internal spires arranged apparently in the same way, excepting that they seem to have their apices directed a little obliquely outwards. He also states that *Terebratula lepida*, Goldfuss, and *T. sublepida*, Murchison, de Vern. and Keyserling, two other similar species, present the external characters of his genus.

All these little shells differ from the typical forms of *Atrypa* in general appearance, mainly in their smaller size, and their generally flat or concave dorsal, and convex ventral, valve. There may be good generic difference between *Cœlospira* and *Zygospira*, but none such seem to us to have yet been pointed out.

NOTE BY F. B. MEEK.—In the Palæontology of the Upper Missouri, page 16, I appended a note in regard to Prof. Hall's name *Zygospira*, which reads as follows:

"In the Fifteenth Report Regents of the University of N. Y., 1862, pp. 154–5, Prof. Hall proposes the name *Zygospira* for a genus of which *Producta modesta*, Say, is the type. It seems, however, that Mr. Conrad had suggested for this shell the generic name *Steno-*

*cisma;* which Prof. Hall proposed in the first vol. Pal. N. Y. (1847, p. 142) to adopt, should this type prove to belong to a distinct genus. As there was, therefore, no necessity for a new name, *Stenocisma* will have to take precedence over *Zygospira.*"

In the Twentieth Report of the Regents Univ. N. Y. on the State Cab. Nat. Hist. for 1867, issued in 1868, and only recently seen by me, Prof. Hall manifests great indignation at the above note, and pretends to see in it all sorts of disingenuous meanings certainly never thought of by the writer. I have no fears, however, that any other person, not suffering under some unfortunate mental affliction, will understand it otherwise than as intended—that is, as merely an effort to correct a manifest error of nomenclature, by which Prof. Hall had associated two different names with the same genus. And be it remembered, that his error is none the less such for all he has said about it.

But if Prof. Hall had contented himself with casting reflections upon me alone, in his remarks, I should scarcely have thought it worth while to notice his imputations of unworthy motives, or his efforts to hold up (with what degree of fairness I leave for others to judge), as an example of the general reliability of my work, an inaccuracy in regard to the original type of *Stenocisma*, into which I was entirely led by this error of his own, in proposing, in 1847, to "restore," as he expressed it, the name *Stenocisma* to *Producta modesta*, Say. That I was so misled by him will be better understood by the following quotation of the paragraph in which he proposed, in 1847, to restore the name *Stenocisma* to Say's type. At the end of his description of this shell, under the name *Atrypa modesta*, he remarks as follows:

"This species, with the three preceding ones, form a group presenting characters which may require a separation from the true *Atrypæ.* These characters consist in the elevation of the dorsal valve along the center, with a depression or sinus on the ventral valve, being the reverse of the usual arrangement. The beak is incurved, with a perforation at the apex, which occupies also a part of the deltidial area, being usually narrow and long."

"Mr. Conrad, some time since, proposed the name *Stenocisma* for some specimens of the group *Atrypæ* or *Terebratulæ*, which he subsequently abandoned. Should the characters here noticed be found persistent, and accompanied by a narrow foramen, I propose to restore the name first indicated by Mr. Conrad for the genus."

Now at the time I wrote the note in the Palæontology of the Upper Missouri, which appears to be so offensive to Prof. Hall, and for a long time after its publication, all my efforts to find where Mr. Conrad had proposed the name *Stenocisma* (or *Stenoschisma*), had been unsuccessful. This arose from the fact that he did not publish it among the descriptions of fossils, or with the usual heading, but merely indicated it, incidentally, in the middle of a rather long paragraph of his general remarks on the fossils of the New York rocks, and, even as there used, it is the less liable to catch the eye, in looking over the pages, because it was not printed in Italics, or even in larger Roman letters than the other matter on the same page. Consequently it was overlooked, and all my impressions of the genus were derived from Prof. Hall's remarks, quoted above.*

Believing I could rely upon Prof. Hall's knowledge of the particular forms the group *Stenocisma* was originally intended to include, and that he must be well enough acquainted with the rules of nomenclature to be aware that he could not "restore the name first indicated" for a genus, by transferring it to an entirely different group from that for which it was first proposed, I naturally enough inferred that Mr. Conrad's type must have been the species *A. modesta*, or some congeneric form. I was the more strengthened in this belief too, by the fact that Prof. Hall, in proposing the name *Zygospira* for the *A. modesta* group in 1862, said nothing about its differing from the type of *Stenocisma*, nor did he then make any allusion whatever to the fact that he had in 1847 proposed to restore for this type, the name *Stenocisma*—which fact he seemed to have entirely forgotten, as I really believe he had, until reminded of it by my note.

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* Prof. Hall affects to think me very censurable for not referring to the work and page where the name *Stenocisma* was originally published. He forgets, however, that *he* did not make any such reference in proposing, in 1847, to restore that name; and I have no doubt now but he failed to do so for the very same reason that I did—that is, because he could not find it. Surely, if he had examined Mr. Conrad's remarks, he would not have fallen into the error he did in transferring the name to *A. modesta*; and if he had not done that, he would have had no occasion to find fault with my note, which in that case would never have been published.

He says *now*, on page 272 of the Regents' Twentieth Report on State Cab. N. H., that he "intended to restore the name *Stenocisma*, should these species [*A. modesta*, etc.] be found to possess characters corresponding with those given by Mr. Conrad." This, however, it will be observed, was not his original language, which is, "should the characters *here noticed* be found *persistent*"[*] (that is, the characters he had just mentioned), "and accompanied by the narrow foramen," which he had just described as "being usually *narrow* and *long*."

But Prof. Hall says "we have the assertion, however, from this Palæontologist [alluding to me] that Mr. Conrad had suggested for this shell (*A. modesta*) the generic name *Stenocisma*." My language was, "it seems, however, that Mr. Conrad had suggested," etc., meaning, of course, that it seemed so from the manner in which Prof. Hall had proposed to *restore* that name. Not being in the habit of speaking positively when in doubt, I used the words *it seems*, to convey the idea that I had not seen Mr. Conrad's description and was relying upon indirect evidence in regard to his type.

A little more than a year back, in looking through the annual Report of the New York Survey, for 1839, I happened to find, for the first time, on page 59, Mr. Conrad's remarks indicating the genus *Stenocisma*, which I quote below, from the middle of a paragraph, leaving the names, as in the original, in Roman letters:

—"The genus Terebratula is wholly unknown, and the shells usually referred to that genus, I propose to group under the generic name Stenocisma, derived from two Greek words signifying narrow fissure, a character these shells possess under the imperforate apex of the larger valve, and which serves to connect the genus with Delthyris, from which it differs in having no cardinal area. This last named character on the other hand connects it with the genus Strigocephalus. I refer to it the common Silurian bivalve Terebratula Schlotheimii, von Buch."

From this, I of course at once saw Mr. Conrad had not mentioned any shell of the type of *A. modesta*, in connection with his proposed genus *Stenocisma*, but, on the contrary, only cited a very dissimilar European shell forming the type of the genus *Camarophoria*[†] and that consequently, Prof. Hall was wholly in error, in proposing to restore the name

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[*] He evidently *now* wishes he had said "consistent" instead of "persistent" in the original, as he adds the former word in brackets, after the latter, in quoting the sentence. It will scarcely be maintained, however, that I am responsible for not understanding it as if the word consistent had been originally used, since, as every Naturalist will at once see, this would change the whole meaning of the sentence.

[†] Prof. Hall now says it was his Lower Helderberg *Rhynchonella formosa*, that Mr. Conrad identified with *T. Schlotheimii*, of Europe, as he knows from a drawing of that species in his possession, with the name *T. Schlotheimii* written under it in Mr. Conrad's own hand; and as it belongs to a distinct genus, he proposes to regard it as the type of *Stenocisma*. This may be well enough, though the drawing and written name only prove this to be *one* of the types referred by Mr. Conrad to *T. Schlotheimii*; for, although Mr. Conrad's identifications were generally very reliable for that early day, it is evident he had confounded several different forms under von Buch's name, since he states, on p 58 of his Report for 1839, that *T. Schlotheimii* ranges down as low as the Trenton limestone in New York, through several of the Silurian formations, and of course far below the range of *R. formosa*.

*Stenocisma* to the group typified by the species *A. modesta.* After seeing this, I prepared for this place a brief note of explanation, but now have had to extend it to greater length, in consequence of Prof. Hall's late remarks.

There is another note at the foot of the same page of the Upper Missouri Palæontology, and immediately under that to which Prof. Hall takes exceptions, in which I mentioned that his name *Goniocœlia* (1861) is a synonym of *Pentagonia*, Cozzens, (1846). He appears not to have noticed this, at any rate he does not hold it up as an example of the accuracy of my corrections of nomenclature; though he quietly drops his own name *Goniocœlia*, and adopts *Pentagonia*, as I suggested would have to be done.

In regard to the personalities used by Prof. Hall, in his remarks under consideration, I would merely state that I have no reply in kind. I have yet to learn that arguments used either in the discussion of scientific subjects, or questions relating to scientific nomenclature, gain anything in force or elegance by the use of such language; and, besides, for other reasons that will be readily appreciated by all gentlemen, I would rather be the subject of a whole chapter of such *refined* expressions every day of my life, than to be guilty of applying one of them to Prof. Hall, or to any other person, in a scientific publication.

## ZYGOSPIRA SUBCONCAVA, M. and W.

Pl. 7, fig. 1 *a*, *b*, *c*, *d*.

SHELL very small, suborbicular, subplano-convex, in some examples a little longer than wide, and in others slightly wider than long; cardinal margins sloping from the beaks at a variable, but always obtuse, angle; lateral margins more or less rounded, or sometimes obtusely subangular at their connection with the more straightened cardinal slopes; front generally rounded.* Dorsal valve slightly, or rather distinctly, convex on each side, and concave along the middle, the concavity being very narrow at the beak, and widening rapidly toward the front. Ventral valve convex along the middle, and sloping laterally; beak small, rather pointed, curved nearly at right angles to the plane of the valves, and projecting slightly beyond the hinge. Surface marked by ten or twelve coarse striæ, or small costæ, some of which bifurcate, while two, on the elevated part of the ventral valve, are generally more prominent, toward the umbo, than the others. A few comparatively strong, regular, concentric marks of growth are also sometimes seen on the larger individuals.

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* In the specimen from which our figures were drawn, the anterior margin is broken a little, so as to make it slightly straighter than natural.

Length, 0.22 inch; breadth, 0.21 inch; convexity, 0.12 inch.

Although we at one time believed this little shell to be only a variety of *Z. concava* (=*Leptocœlia concava*, Hall), farther comparisons with New York specimens of that species have led us to the conclusion that it must be specifically distinct, though an allied representative form. In general appearance, size, &c., it is much like *Z. concava*, but a careful comparison shows it to differ in the following characters: In the first place, its dorsal valve is moderately, or rather distinctly, convex on each side, instead of flat; while the concavity along its middle is widest and deepest *at the front*, instead of near the middle. Again, it has a smaller number, and rather larger, as well as more depressed, costæ, which become nearly obsolete towards the front and sides.*

Figure 1 *b* shows the convexity of the dorsal valve in the most compressed specimen we have seen; while in the only other specimen we have showing that valve, it is considerably more convex. In both of these examples the beak of the dorsal valve is also somewhat incurved, instead of straight, as in *Z. concava.*

*Locality and position:* Limestone at Bailey's Landing on the Missouri river, in Perry county, Missouri; of the age of the Delthyris shale, of the N. Y. Lower Helderberg (Upper Silurian) series.

## GENUS TREMATOSPIRA, Hall, 1859.

(Regents' State Cab. Report, p. 27.)

### TREMATOSPIRA? IMBRICATA, Hall.

Pl. 7, fig. 2 *a, b, c, d, e.*

*Leptocœlia imbricata*, HALL, 1857. Ann. Report Regents Univ. N. Y., for 1856, p. 108; Palæontology N. Y., vol. III, p. 246, pl. xxxviii, fig. 8—13.

SHELL small, rhombic-suborbicular, plano-convex, or concavo-convex; length sometimes a little greater, and in other examples somewhat less, than the breadth; cardinal margins sloping at various angles from the beaks; lateral margins more or less rounded, or obtusely subangular, front rather irregularly rounded. Dorsal valve nearly flat on each side, and more or less concave in the middle; beak not incurved. Ventral valve convex along the middle, and sloping to the sides; beak incurved a little beyond the hinge. Surface ornamented by about seven to ten rounded plications on each valve, two of which, on the middle of the ventral valve, are larger and more prominent than the others, while the middle one on the other dies out before reaching the beak. Crossing the whole are distinct, rather distant, regularly arranged, imbricating lamellæ of growth.

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* The costæ on the enlarged figure 1 *d* are represented proportionally too small, and more numerous than they should be, as well as too strongly defined near the margins.

Length, 0.27 inch; breadth, 0.23 inch; convexity, 0.10 inch.

We have seen only two good specimens of this little shell, and of course are unprepared to say to what extent it may vary. The two we have seen are proportionally a little narrower than most of the New York examples of *T. imbricata*, and one of them (the one we have figured) has the dorsal valve decidedly concave, though the other has it nearly flattened, or very slightly convex, on each side, and a little concave along the middle. Their costæ are also slightly larger and less numerous than on the majority of the New York specimens with which our comparisons have been made. Without more specimens, it is not possible to decide whether these are specific differences or not, though we incline to the latter opinion, because the New York specimens vary considerably in most of these characters.

We observe Prof. Hall states, on page 60, Appendix D, of the Sixteenth Ann. Report Regents University of New York, that "*Leptocœlia imbricata* proves to be a *Trematospira*." Without knowing the internal characters of this species, we are of course unprepared to express any decided opinion on this point. Yet it is worthy of note that, in addition to the deeply concavo-convex form of some of these shells, which would alone seem to indicate a different arrangement of the internal spires from what we see in *Trematospira*, we have been entirely unable to detect any traces of the punctate structure, at least doubtfully given as characteristic of the typical forms upon which *Trematospira* was proposed—in either New York or western examples of the species *imbricata*. It is possible, however, that very carefully prepared sections, from well preserved examples, might show such punctures.

*Locality and position:* Same as last.

## GENUS CYRTINA, Davidson, 1858.

(Monogr. Brit. Carb. Brach, p. 66.)

### CYRTINA DALMANI, Hall (sp.)

Pl. 7, fig. 3 *a*, *b*.

*Cyrtia Dalmani*, HALL, 1857. Report Regents University New York for 1856, p. 64; Palæont. N. Y., vol. III, p. 206, pl. xxiv, fig. 1 *a–y*.

SHELL small, trigonal; very inequivalve; hinge equaling the greatest breadth, which is usually nearly twice the length. Ventral valve very convex, or subpyramidal; beak elevated, somewhat pointed and but slightly curved, or nearly straight; area triangular, wider than high, distinctly defined, flat, or very slightly arched; foramen narrow, and closed (excepting near the beak) by a convex deltidium; ventral sinus of moderate depth and breadth, sometimes angular; lateral slopes with each four or five simple, rather rounded, or subangular plications, of which the two bounding the mesial sinus are larger and more prominent than the others; surface with concentric imbricating marks of growth.

Length, 0.25 inch; breadth, 0.40 inch; convexity, 0.25 inch.

We have only seen ventral valves of this shell, none of which have the area quite as high as some individuals of the *C. Dalmani*; but as that form varies considerably in this respect, and we have been unable to discover any reliable specific differences in the few specimens yet seen of the shell under consideration, we can but refer it to the New York species. Although we have not seen the interior, and none of our specimens are in a condition to show the shell structure, we can scarcely doubt that it is a *Cystina*, since we can see that it has a distinct mesial septum extending to and apparently connecting with the interior of the deltidium, as is the case with some species of that group, but unknown, we believe, in *Cyrtia*. The interior of the New York specimens have not been illustrated, but the shell is described as being "granulo-punctate."

*Locality and position:* Same as last.

## GENUS SPIRIFER, Sowerby, 1815.

(Min. Conch., vol. II, p. 42.)

### SUBGENUS TRIGONOTRETA, Kœnig, 1825.

### SPIRIFER PERLAMELLOSUS, Hall.

Pl. 7, fig. 9 *a*, *b*.

*Spirifer perlamellosa*, HALL, 1857. Regents' Report University of N. Y., for 1856, p. 57.
*Spirifer perlamellosus*, HALL, 1859. Palæont. N. Y., vol. III, p. 201, pl. xxvi, fig. 1–2.

OUR specimens of this shell are too imperfect to enable us to give a full description, or to compare, in detail, all its characters with the New York species. As far, however, as they show its specific characters, it seems to agree exactly with *S. perlamellosus*. None of them are as large as the larger individuals of the species found in the east, but they show the same rather large, rounded plications, crossed by distinctly projecting, undulating lamellæ of growth, marked by traces of very fine radiating striæ. As in the New York examples, the mesial fold of the dorsal valve is prominent and round; and the beak and area of the ventral valve distinctly incurved.

*Locality and position:* Bailey's Landing, Perry county, Missouri; from a limestone of the age of the Delthyris shaly limestone of the New York Lower Helderberg Group. Upper Silurian.

# GASTEROPODA.

## GENUS PLATYCERAS, Conrad, 1840.

(Palæont. N. Y., p. 205.)

*Platyceras*, CONRAD, 1840. Ann. Report Palæont. N. Y., p. 205; HALL (1859), Report Regents University N. Y., p. 16; Palæont. N. Y., vol. III (1857), p. 309; MEEK and WORTHEN, (1866), Proc. Acad. Nat. Sci., Philad., p. 202.
*Acroculia*, PHILLIPS, 1841. Palæozoic Fossils, p. 93; RŒMER (1843), Verst. d. Harzgeb., p. 26; de KONINCK (1843), Terr. Houill., p. 332; HALL (1852), Palæont. N. Y., vol. II, p. 218.
*Capulus*, in part, of authors (not MONTFORT?)

THE genus *Platyceras* was proposed by Mr. Conrad for a group of shells, mainly if not entirely confined to the Palæozoic rocks, and most generally referred by European authors to Montfort's genus *Capulus*, published in 1810 (=*Pileopsis*, Lemarck, 1812). Mr. Conrad's description of this genus reads as follows:—

"I propose to group in this genus the *Pileopsis tubifer*, *P. vetusta* and *Nerita haliotis*, Sowerby, and perhaps *Bellerophon cornuarietes*. These shells are suboval, or subglobose, with a small spire, the whorls of which are sometimes free and sometimes contiguous; the mouth is generally campanulate or expanded."

During the following year, Prof. Phillips proposed in his "Palæozoic Fossils," the name *Acroculia*, for this same group of shells, with the following description: —

"*Provisional characters.*—Obliquely spiral, the apex free, the aperture ample, without columella, a sinus in the right lip." He mentions but the two species, *Pileopsis vetusta*, Sowerby, and a new species of his own, *A. sigmoidalis*, both of which are typical species of *Platyceras*.

In this country Mr. Conrad's name has been generally adopted for these shells, which is certainly proper, if we separate them from *Capulus*, since his name has priority of date over that proposed by Prof. Phillips. Although agreeing with those who regard these shells as being probably distinct from the existing genus *Capulus*, we believe they are more nearly allied to that group than is generally supposed to be the case by most American Palæontologists. The only reason assigned by Prof. Hall for separating them from the modern genus is that he had never observed in them any traces of the peculiar horseshoe shaped muscular scar so conspicuous in the genus *Capulus*[*] We have, however, found a similar muscular impression in two distinct species of this genus, one of which seems to be a variety of *P. subrectum*, Hall, from the Keokuk group, while the other is a new species described by us in this volume, under the name *P. subplicatum*, from the Waverly group, of Ohio. In both of these, internal casts show an elongated muscular impression on each side, connected by a linear band passing around behind. It is also worthy of note that both of these species belong to the nearly or quite straight section of the genus, for which Prof. Hall at one time proposed the name *Orthonychia*,[†] and, hence, are less nearly like the modern typical forms of the genus *Capulus*, than the majority of the Palæozoic species.

A careful examination of extensive collections of these shells, from our western palæozoic rocks, has also led us to believe that the animal was probably similar in habits to *Capulus* and other types of the family *Capulidæ*, to which they evidently belong,[‡] in being sedentary. This is shown by specimens found attached to crinoids and other objects in such a manner that the sinuosities of the lip exactly correspond to the irregularities of the surface, to which they are attached. For instance, we have now before us one of these shells attached to the side of a *Pentremites Godoni*, so as entirely to cover one of the pseud-ambulacral fields and two of the intermediate areas, and yet the sinuosities of its lip conform so exactly to the irregularities of the side of the *Pentremite* that the connection looks as if it might have been air tight. The corresponding undulations of the lines of growth likewise show clearly that this nice adaptation of the margins of the lip to the irregularities of the surface of the *Pentremite* could not have resulted from accidental pressure when the edge of the lip was somewhat yielding, since the curves in the marks of growth are seen to extend up the sides of the shell some distance from the margin, where there could have been no flexibility.

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[*] Twelfth Annual Report Regents University New York, p. 16, 1859.

[†] Report Fourth District New York, 1843.

[‡] In a sheet entitled "Iowa Geological Survey, Supplement to vol. I, part ii, 1859," issued in 1860, Prof. Hall described a patelliform *Platyceras*, from Nauvoo, Illinois, under the name of *P. fissurella*, which he says has a perforation just anterior to the apex. Although this is merely mentioned as a specific character, distinguishing it from an otherwise similar species, described in the same paper, Conchologists will readily understand that such an opening, near the apex of the shell, if natural, must have been, judging from all analogy, for an excurrent or anal siphon, as in the *Fissurellidæ*, and hence would not

This habit of attaching themselves to crinoids, has led some to think the crinoids were in the act of devouring these mollusks at the moment when they perished, and that these mollusks constituted the chief food of the crinoids. So far as our observations go, however, we do not think the evidence sufficient to establish this conclusion, since these shells are as often attached to the side of the crinoid below the horizon of the arms as to the summit, and hence out of reach of the mouth, while the conformity of the margins of the shell to the inequalities of the surface to which they are found attached, rather indicate that they grew there. The probability seems to be, that like various other sedentary marine animals, these mollusks, in their very young state, floated freely about until they found a suitable place to attach themselves. We were at one time inclined to think there might also be some reason for believing that the adult shell, at least sometimes, changed its station, from the fact that in some instances we observe the lines of growth indicating strong sinuosities in the lip during a part of the growth of the shell, which afterwards became suddenly obliterated, to give place to a different set of irregularities, as if the animal had changed its station and adapted the sinuosities of its lip to a new surface. This, however, may have been produced by the lateral expansion of the lip, by which it was brought into contact with different inequalities as the shell increased in size, or from accidental breaks in the lip, during the life of the animal. We have no evidence that they possessed the power of excavating a depression in the surface of attachment, as in *Amalthea*, or of secreting a shelly layer or support under the foot, as in *Hipponyx*.

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only remove the species from the genus *Platyceras*, but from the family *Capulidæ*, and place it in the *Fissurellidæ*, regarded by some systematists as belonging to a distinct order from that including the *Capulidæ*. A careful examination, however, of the typical specimen of *P. fissurella*, and other examples of the same species from the original locality, now in the possession of one of the writers, leads us to think the perforation alluded to (which only exists in one of the specimens), is almost beyond doubt an accidental break in the shell, and not a natural perforation.

Prof. Hall has proposed to establish two subordinate groups under this genus, more or less distinct from the typical forms of *Platyceras*. These may be distinguished thus: —

1. *Platyceras*, Conrad. (Typical.) Shell with apex incurved or spiral; surface concentrically striated, sometimes radiately plicate, rarely spiniferous. *Pileopsis tubifer*, Sow.

2. *Orthonychia*, Hall. Shell arched or straight, with concentric striæ. *Platyceras subrectum*, Hall.

3. *Igoceras*, Hall. Differing from the last in having the surface cancellated. Ex. *P. plicatum*, Conr. (sp.)

It is, however, often very difficult to distribute the species into these groups, owing to the numerous gradations by which they blend into each other.

## PLATYCERAS SUBUNDATUM, M. and W.

Pl. 7, fig. 13 *a*, *b*, and 14 *a*, *b*.

Compare *Platyceras multisinuatum*, and *P. intermedium*, HALL; Palæont. N. Y., vol. III, pl. 58.

SHELL obliquely irregular-oval, composed, at maturity, of about three and a half rounded volutions, the first two and a-half or three of which increase rather rapidly in size, are closely coiled together, and depressed with the spire on a level with, or below, the upper side of the outer turn; body portion, in adult shells, very rapidly expanding, so as to cause the upper side to rise considerably above the inner turns, with which, however, it continues very nearly or quite in contact, even at the aperture, which is large and subcircular, or transversely oval; lip with its margin all around, excepting on the inner side, undulated in adult shells, so as to form some eight or ten more or less defined sinuses, with projecting processes between. Surface in the young shell with fine, somewhat undulated, striæ of growth, which in the adult become more strongly defined, and more distinctly undulated towards the aperture, as they cross short, more or less distinct, longitudinal ridges, or obscure, rounded plications, developed there.

Greatest length of an adult shell, 1.90 inches; transverse diameter of the aperture, 1.40 inches; height of same, about 1.30 inches.

Although this shell resembles several of the New York forms, and we at one time supposed it to be the *P. Gebhardi*, further comparisons with good specimens of that species, and *P. ventricosum*, from New York, and Cumberland, Maryland, have led us to the conclusion that it cannot be properly referred to either of those forms. At any rate, it differs from them both, as well as from some of the other more or less similar New York forms, upon quite as good characters as those by which they are distinguished from each other. From *P. Gebhardi* and *P. ventricosum* it differs in having the body whorl rather distinctly plicated, and nearly or quite contiguous at the aperture, and its lip strongly undulated or sinuous all around, excepting on the inner side, in adult specimens. Its volutions also expand more rapidly than those of *P. Gebhardi*. In the subplicate character of its body volution, and its undulated or sinuous lip, it resembles *P. multisinuatum*, Hall; yet it differs from that shell in having its spire more depressed, its volutions more rapidly expanding, and the last one never becoming distinctly free, while they are all without traces of plications, excepting the last one near the aperture. In some respects it is more nearly like *P. intermedium*, Hall, but it differs from that form in not having the body straight and free, and in having its lip more strongly undulated and plicated, as well as in having its apex more spiral.

We are aware that there is great difficulty in separating the species of such shells, and that after all the care and study that can be bestowed upon them, we cannot always feel quite confident that our conclusions are free from error. We can only say, however, that with an earnest desire to identify the shell under consideration with some of the New York species, we have felt that we would be more liable to err in doing so, than to regard it as a distinct species, and that, if the characters relied upon to distinguish the several New York forms mentioned are valid specific distinctions, our shell cannot be properly referred to any of them.

It is proper that we should explain here, that the irregularities in the dorsal outline of our figure 14 *a*, are due to some adhering portions of the matrix. A fracture across the spire of this specimen also shows that it has the same number of turns seen in figure 13 *b*. The adhering portion of the matrix that hides the smaller turns of the spire, also makes the body volution appear quite free from the spire. The lip, however, comes very nearly or quite in contact with the recurved spire, as may be seen by the other view of the same specimen, represented by figure 14 *b*.

*Locality and position:* Bailey's Landing, Perry county, Missouri; in limestone representing the "Shaly Limestone" of the N. Y. Lower Helderberg series. Upper Silurian.

## PLATYCERAS SPIRALE, Hall.

Pl. 7, fig. 12 *a*, *b*, *c*.

*Platyceras spirale*, HALL, 1859. Palæont. New York, vol. III, p. 331, pl. 68, fig. 4–9.

SHELL having a more or less irregularly elongated, and twisted, very rapidly ascending, spiral, or subspiral form; the few turns being more or less rounded, rather slender, and widely disconnected, or drawn out, excepting at the apex, where the small first volution is, in most examples, abruptly and closely coiled. Aperture subcircular, and, in large shells, expanded; lip somewhat sinuous. Surface, in young shells, smooth, excepting fine, rather obscure lines of growth; but in adults, with usually a few longitudinal plications on one side, crossed by stronger, undulating marks of growth.

Large specimens of this species sometimes attain a length of two and a half inches, with an aperture expanded to one and a quarter inches in diameter. It is a very variable shell, in general form, but always has its whorls much drawn out, excepting the first one or two. Our specimens agree quite as well with New York examples of *P. spirale*, as the latter do with each other. Those we have figured have the apex of the spire broken away, but another smaller one, too much enveloped in the matrix to be readily drawn, shows that its apex is closely coiled, as in the New York specimens. Another larger individual, also mainly embedded in the matrix, has the plications as well defined on one side as in figure 8, of the New York illustrations cited above.

*Locality and position:* Bailey's Landing, Perry county, Missouri; Lower Helderberg division of the Upper Silurian.

## PLATYCERAS (ORTHONYCHIA) PYRAMIDATUM, Hall?

Pl. 7, fig. 11.

*Platyceras pyramidatum* HALL, 1859. Palæont. N. Y., vol. III, p. 336, pl. 64, fig. 7, and 9.

SHELL subpyramidal, or subconical, being nearly or quite straight, and much expanded, except at the apex, which is more or less attenuated; aperture subcircular, or irregularly subquadrangular, in consequence of the development of a few irregular, large obtuse folds around the lower part of the shell; lip with a few broadly rounded irregular undulations, or shallow sinuosities. Surface marked by lines of growth, which are obsolete above, but become stronger and distinctly undulated parallel to the outline of the lip, below the middle.

Length of a specimen with a part of the apex broken away, 2.10 inches; breadth, about 1.40 inches.

This shell agrees in its general appearance with *P. pyramidatum*, and most probably belongs to that species; but as we have only a single imperfect specimen for comparison, and the typical specimens upon which the species *pyramidatum* was founded (or at any rate those figured), are merely imperfect casts, the identification can only be regarded as provisional. It will be observed that our figure represents the shell as being more ventricose in the middle, and less expanded at the aperture, than the New York species. This, however, is partly due to distortion, from accidental pressure. The specimen shows no traces of the longitudinal striæ, doubtfully given as one of the characters of the New York shell.

It is not possible to say whether the apex in these shells was straight or curved, from our specimen, or those figured in the New York Palæontology, in all of which it is broken away.

*Locality and position:* Same as last.

# ARTICULATA.

## *CRUSTACEA.*

### Genus ACIDASPIS, Murchison, 1839.

(Sil. Syst., vol. II, p. 658.)

### Acidaspis hamata, Conrad (sp.)

Pl. 7, fig. 16.

*Dicranurus hamatus*, Conrad, 1841. Ann. Report Palæont. N. Y., p. 48, pl. —, fig. 1.
*Acidaspis hamata*, Hall, 1859. Palæont. N. Y., vol. III, p. 371, pl. lxxix, fig. 15-19.

Of this species, we have but the single fragment figured, which consists of the curious bifurcating appendage extended from the back part of the head, in the form of two elongated, hooked spines. The hooked extremities curve down into the matrix, and are not seen in our figure.

Although this fragment agrees well with the corresponding part of Conrad's species, so far as can be seen, we can not be positively sure that it is really the same, for there might be two otherwise distinct species agreeing exactly in this appendage.

*Locality and position:* Same as last

## GENUS DALMANITES, Auct.

(*Dalmania*, Emmrich, 1845 (not Rob., 1830),—*Odontochile*, Corda, 1847 (not Lap., 1834.)

### DALMANITES TRIDENTIFERUS, Shumard.

Pl. 7, fig. 16.

*Dalmania tridentifera*, SHUMARD, 1855. Geol. Report Missouri, p. 199, pl. B, fig. 8 *a*, *b*.

"HEAD sub-semicircular, but little elevated, granulose; external border wide, slightly raised, and with a broad shallow groove extending nearly the entire length; front extended into a remarkable three-lobed process, about four lines wide at the base, and three and a half lines long; the lobes angulated and bent slightly upwards; one, a little largest, projects forward from the middle of the process, and occupies about half its length; the others arise from behind the central lobe, and project laterally, one on either side, their extremities being about five lines apart. On each side of the process the border is notched about half its width. The genal angles are broad, flattened-convex, and slightly curved at the tip; their length about equal to the head, exclusive of the frontal process. Glabella very moderately convex; frontal lobe transverse, somewhat lozenge-shaped, with the angles rounded, occupying more than one-half the length of the glabella, including the occipital ring, and separated from the cheeks by a well-defined dorsal furrow, which becomes obsolete in front; lateral furrows well impressed, and extending rather more than one-third the distance across the glabella; anterior pair directed obliquely backwards, forming, with the axis, an angle of about seventy degrees; second pair directed forwards; posterior pair transverse. Eyes large, lunate, very close to the glabella, and extending from the occipital to the anterior lateral furrows.

The visual surface of each eye contains about 38 vertical rows of lenses, the maximum number of a row being ten, the whole number about 350. The cheeks are very slightly convex."

"Pygidium sub-trigonal, flattened-convex; border from a-half to a line wide, prolonged posteriorly into a pointed spine from one to two lines long. Axis but little raised above the lateral lobes, forming about one-fourth the entire width, tapering gradually, rounded and slightly prominent at the extremity, from which an obscure carina extends to the caudal spine; rings fourteen, flattened-convex, separated by narrow grooves; lateral lobes, with nine or ten segments, gently curved, and their extremities coalescing with the border; furrows rather wide but shallow, each with two shallow pits near the border, separated by a slightly raised carina."

Having but fragments of this species, and believing that it will probably be found in the same rock in the south-western part of this State, we have thought it desirable to give Dr. Shumard's entire description for the use of students who may not have access to the Missouri Report, as it was drawn up from much better specimens than those we have.

Our figured specimen shows only the under side of the margin of the head, with its tridentate anterior process, and produced posterior lateral spines. It will be observed, that the divisions of the tridentate process appear not to be so long and pointed as in Dr. Shumard's figure. This, however, is due to the fact that these divisions curve upwards so as to be partly hidden in the matrix, as we have ascertained since the figure was drawn, by working away some of the surrounding rock. Its anterior margins, immediately on each side of the tridentate process, are also less sinuous than in Dr. Shumard's figure. But as our specimen came from the same locality and position as his, we can but regard this difference as being due either to the fact that our specimen shows only the under side, and his the upper, or to a slight individual variation.

This species is evidently a representative of the New York Shaly Limestone *D. tridens*, of Hall, which has the same kind of a tridentate process, though much longer, extending from the anterior margin of the head. It is interesting to see so many representative forms of the New York Shaly Limestone fossils at this western locality.

*Locality and position:* Bailey's Landing, Perry county, Missouri; Shaly Limestone of the Lower Helderberg Group of the N. Y. Upper Silurian.

# DEVONIAN SPECIES.

## FOSSILS OF THE ORISKANY GROUP.

## MOLLUSCA.

### BRACHIOPODA.

### GENUS LEPTÆNA, Dalman, 1827.

(Uppstalln. af Terebr.)

### LEPTÆNA ? NUCLEATA, Hall.

Pl. 8, fig. 8 *a*, *b*, *c*, *d*.

*Leptæna nucleata*, HALL, 1857. Ann. Rep. Regents Univ. N. Y., for 1856, p. 47.
*Leptæna ? nucleata*, HALL, 1859. Palæont. N. Y., vol. III, p. 419, pl. xciv, fig. 1 *a*, *b*, *c*, *d*.

SHELL very small, semicircular, concavo-convex, greatest breadth on the hinge margin; length from three-fourths to two-thirds the breadth; lateral extremities rather acutely angular, or forming less than right angles; front regularly semicircular in outline. Ventral valve very gibbous in the central region, with lateral extremities compressed; beak strongly incurved, with its point extending a little beyond the hinge margin; area very narrow, and rendered oblique by the curving of the beak; interior with a prominent linear mesial ridge, or low septum, extending from the beak nearly to the middle of the valve, and leaving a very distinct slit in the beak of internal casts.* Dorsal valve moderately concave, and roughened internally by sharply elevated radiating lines, more or less broken up into projecting points, over a fan-shaped area, occupying most of the interior surface; beak and area obsolete; cardinal process prominent, narrowed at the base, and faintly trifid at the extremity, like that of some species of *Productus*. Surface of both valves smooth, excepting a few subimbricating marks of growth. (Muscular scars unknown.)

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* This slit is carried a little too far forward in fig. 8 *d*, and should end more abruptly.

Length, 0.15 inch; breadth, 0.20 inch; convexity, about 0.10 inch.

This curious little shell does not present the form or internal characters of *Leptæna*, and will probably be found to be a new generic type. As we only know it from moulds and casts in the matrix, however, we prefer to leave it provisionally under the name *Leptæna*, rather than attempt to found a new genus upon such inferior specimens as we have yet seen. It seems to agree exactly with the New York species, which is not yet known to occur at any other western locality.

*Locality and position:* Cherty limestone, belonging to the horizon of the Oriskany sandstone of the New York Devonian series; Township 14, Range 2, Alexander county, Illinois.

## GENUS RHYNCHONELLA, Fischer, 1809.

(Mem. Soc. Imp. Mosc. II.)

### RHYNCHONELLA SPECIOSA, Hall.

Pl. 8, fig. 9.

*Rhynchonella speciosa*, HALL, 1857. Report Regents University, N. Y., for 1856, p. 81; Palæont. N. Y. (1859), vol. III, p. 444, pl. ciii A, fig. 1—6.

SHELL attaining a large size, sub-equivalve, in young examples subovate, becoming longitudinally oblong-oval, and extremely gibbous in adult specimens, which are often longer than wide; without mesial fold or sinus in either valve; sides flattened and often more or less straightened, and nearly parallel, or but slightly convex; front subtruncated, or more or less rounded; anterior and lateral margins of both valves abruptly curved, or deflected towards each other, and united by deeply interlocking, sharply angular serratures. Dorsal valve very convex, but somewhat flattened on top; beak regularly incurved; cardinal margin deeply sinuous on each side of the beak for the reception of corresponding rounded prominences of the margin of the other valve; interior provided with a thickened cardinal process, from which a prominent mesial septum extends forward towards the middle of the valve. Ventral valve somewhat less convex than the other, which it nearly resembles in other respects, excepting that its rather obtuse beak is a little more prominent and arched over that of the other valve; entire breadth of deflected anterior margin somewhat prominent, and occupying a corresponding broad shallow sinuosity of the margin of the other valve. Surface of both valves ornamented with numerous, simple, regular plications, which are flattened or rounded on the posterior portions of the valves, but become more prominent and subangular on the front.

Length of an adult shell, 2.07 inches; breadth, 1.44 inches; convexity, about 1.50 inches.

This is one of the largest and most symmetrical species of the genus known. It is remarkable for having neither mesial fold nor sinus, the valves being nearly equally convex. We are not aware of its occurrence at any other western locality.

*Locality and position:* Bald Rock, Jackson county, Illinois; in a light gray subcrystalline, cherty limestone, of the age of the Oriskany sandstone, of the New York Devonian series.

## GENUS EATONIA, Hall, 1857.*

(Regents' State Cab. N. H. Report for 1856, p. 90.)

### EATONIA PECULIARIS, Conrad, sp.

Pl. 8, fig. 2 *a*, *b*, *c*, *d*.

*Atrypa peculiaris*, CONRAD, 1841. Annual Report Palæontology N. Y., p. 56; VANUXEM, (1842), Geol. Report Third Dist. N. Y., p. 128, fig. 8; HALL (1843), Geol. Report Fourth Dist., p. 148.

*Eatonia peculiaris*, HALL, 1859. Twelfth Ann. Rep. Regents Univ. N. Y., p. 87. fig. 1–7; Palæont. N. Y., vol. III (1859), p. 244, pl. xxxviii, fig. 21–26, and pl. ci, fig. 2.

SHELL rather under medium size, slightly longer than wide, or with length and breadth nearly equal, becoming rather convex in adult examples, greatest convexity and breadth generally in front of the middle; subtruncated, or more or less prominent in outline in front; sides converging more or less rapidly to the beaks. Dorsal valve more convex than the other, particularly in the middle, thence rounding off rather rapidly to the sides; anterior margin rising in the middle to a more or less prominent mesial fold; beak incurved. Ventral valve compressed, convex near the beak, and flattened, or a little concave towards the sides, which are so abruptly deflected at right-angles to the flattened disc, as to present distinctly rectangular margins from near the beak to the front; anterior margin curving abruptly towards the other valve, and produced into a tongue-shaped projection, filling a corresponding sinuosity (not an imargination) in the front of the dorsal valve, on each side of which the immediate edges of both valves show a few crenatures, or rudimentary plications, scarcely visible externally; beak a little more prominent than that of the other valve, and somewhat arched, with a small rounded terminal foramen. Surface marked with small, moderately distinct, bifurcating radial striæ, one of which is sometimes a little larger than the others in the middle of the mesial sinus of the ventral valve, and corresponds to a slightly larger furrow between two of those on the middle of the fold of the other valve.

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* Prof. Hall *used* the name *Eatonia* in 1857, in the Regents' Report for 1856, but he did not *describe* the genus until 1859.

Length, 0.75 inch; breadth, 0.70 inch; convexity, 0.50 inch.

We have seen only one tolerably good specimen, and some fragments of this shell; but as far as we have been able to compare its characters with those of authentic examples of *Eatonia peculiaris*, from New York, we have been unable to find any reliable specific differences. The only nearly perfect individual seen (that figured), seems not to have the mesial fold quite so distinctly elevated at the front margin, as in the New York examples; but as it has that part slightly distorted by pressure (the distortion is not represented in the figure), and the New York specimens vary somewhat in the distinctness of the mesial elevation, we have scarcely any doubt in regard to its identitv with the New York shell. So far as we know, this species has not been found at any other locality west of New York.

*Locality and position:* Same as last.

## GENUS LEPTOCŒLIA, Hall, 1857.*

(Regents' Report for 1856, p. 107.)

### LEPTOCŒLIA FLABELLITES, Conrad, (sp.)

Pl. 8, fig. 3 *a*, *b*, *c*.

*Atrypa flabellites*, CONRAD, 1841. Ann. Report Palæont. N. Y., p. 55.
*Leptocœla propria*, HALL, 1857. Ann. Report Regents Univ. N. Y., for 1856, p. 108; Extr. from same (1857), p. 68.
*Leptocœlia flabellites*. HALL, 1859. Palæont. N. Y., vol. III, p. 449, pl. cvi, fig. 1 *a–f*; and pl. ciii B, fig. 1 *a–g*.

SHELL flabelliform, or suborbicular, generally a little wider than long, compressed plano-convex; cardinal margins straight on each side, and converging to the beaks, at an angle of about 100° to 150°; sides somewhat rounded, or sometimes obtusely subangular at the terminations of the cardinal slopes; anterior margin more or less rounded. Dorsal valve nearly flat; beak slightly less prominent than that of the other valve, and not incurved. Ventral valve moderately convex along the middle, and sloping to each side; beak curved so as to be directed nearly at right-angles to the plane of the shell, rather small, and provided with a minute rounded opening at the apex; bounded on the inner side by the deltidium. Surface of each valve ornamented by about fourteen simple, depressed, or subangular radiating plications, two of which on the middle of the ventral valve are larger and more prominent than the others, with a smaller one depressed between them, so as to form a small mesial sinus, corresponding to a low mesial elevation towards the front of the other valve, formed by the two middle plications, which are a little larger and more prominent than those on each side, from which they are separated by deeper furrows than those between the lateral ones. A few obscure undulations of growth are also sometimes seen crossing the plications.

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* Prof. Hall used this name in the Regents' Report for 1856, published in 1857, but without a generic description. He described the genus in the Regents' Twelfth State Cab. Report, in 1859.

This species varies somewhat in proportional length and breadth; the wider specimens also have the lateral slopes of the cardinal margin diverging from the beaks at a greater angle. The specimen from which our figures were drawn is somewhat distorted and exfoliated, and does not show the specific characters as clearly as some since obtained. We have no doubt of its specific identity with the New York shell, which has not, we believe, been found at any other locality west of that State.

*Locality and position:* Dry fork of Clear creek, Union county, Illinois; from a Cherty limestone of the age of the Oriskany sandstone of the New York Devonian series.

## GENUS SPIRIFER, Sowerby, 1815.

(Min. Conch., 11, p. 42.)

### SUBGENUS TRIGONOTRETA, Koenig, 1825.

### SPIRIFER ENGELMANNI, M. and W.

Pl. 8, fig. 5 *a*, *b*, *c*, *d*.

SHELL of medium size, rather convex, about twice as wide as long; hinge line equaling the greatest breadth; lateral extremities compressed and rather acutely angular; anterior lateral margins converging with a somewhat convex outline to the rather deeply sinuous front; valves nearly equally convex, the dorsal being most prominent anteriorly, and the ventral towards the umbo. Dorsal valve distinctly compressed in the posterior lateral regions; mesial elevation without plications, very narrow at the beak, but widening and becoming rather rapidly more elevated in front, where it is subangular, or more or less rounded; beak but little prominent, and with the narrow area incurved. Ventral valve distinctly more gibbous than the other in the umbonal region, and strongly arched; lateral slopes convex, excepting near the hinge; mesial sinus smooth, commencing very narrow at the beak, and widening and deepening to the front, not defined on either side from the convex lateral slopes by prominent marginal plications;* beak prominent and distinctly incurved; area of moderate height, rather well defined, with nearly parallel margins near the beak, but narrowing rapidly to the extremities, distinctly arched and inclined back over the hinge; foramen wider than high, but narrowing near the beak. Surface ornamented by 12 to 15 simple, rather rounded plications, on each side of the mesial fold and sinus, crossed near the front by a few rather-distinct ridges of growth.

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* The marginal plication on the left side of the sinus in fig. 5 *b* is made to appear too prominent and not rounded enough. In the shell, the surface rounds into the sinus on both sides.

Length, 0.93 inch; breadth, 1.70 inches; convexity, 0.80 inch.

It is probable that specimens of this species, with the surface not exfoliated, would show some more or less distinct, finer undulating marks of growth. We also think we have seen, on some of the specimens, indications of fine radiating striæ. Internal casts of the ventral valve show that its rostral cavity is large, and marked with the curved radiating striæ often seen in analagous species.

This species will be at once distinguished from the next, by its more ventricose ventral valve, with its strongly incurved produced beak and area, as well as by having the plication on each side of the mesial sinus of the ventral valve more depressed, and the lateral slopes more convex. Its cardinal area is also not so high, and much more arched and inclined back over the hinge. It may perhaps be regarded as a representative of the New York Oriskany species *S. arrectus*, Hall, from which it differs in having smaller plications, a less prominent dorsal valve, and a much more strongly arched ventral beak.

Named in honor of Mr. Henry Engelmann, who collected the specimens described, while engaged in surveying some of the southern counties.

*Locality and position:* Cherty limestone of the age of the N. Y. Oriskany division of the Devonian; Township 12, Range 2, Union county, Illinois.

## SPIRIFER HEMICYCLUS, M. and W.

Pl. 8, fig. 6 *a*, *b*, *c*, *d*; and 7 *a*, *b*.?

SHELL nearly semicircular, moderately convex; breadth nearly or quite twice the length; hinge margin equaling the greatest breadth; lateral extremities rather acutely angular, or sometimes a little rounded. Dorsal valve moderately convex in the central region and compressed at the lateral extremities, beak incurved; mesial ridge narrow, abrubtly elevated, its sides being nearly perpendicular, somewhat flattened or a little concave on top, and without plications;* area narrow and incurved. Dorsal valve more convex than the other at the beak; lateral slopes nearly straight; beak moderately prominent and but little curved, somewhat remote from that of the other valve; area of medium height, very sharply defined by the straight angular lateral slopes of the beak, narrowing regularly to the extremities of the hinge, but slightly arched, or nearly flat, and ranging at right angles to the plane of the valves, or inclined a little backward; foramen nearly or quite as wide as high; mesial sinus corresponding in size to the narrow mesial elevation of the other valve, and very sharply defined by the prominence of the first plication on each side. Surface ornamented by from ten to twelve, simple, moderately distinct, subangular plications, on each side of the mesial fold and sinus.

Length of the most nearly perfect specimen seen, 0.60 inch; breadth, 1.25 inches; convexity, 0.45 inch.

The specimens of this species yet obtained are all more or less broken and distorted, so that we have not the means of giving very good figures of it, though most of its characters can be made out from the different specimens taken together. Although not unlike several of the described species, we have been unable to identify it satisfactorily with any of them, and believe it to be new. Its most marked characteristics are the straightness or very slight convexity of the slopes of its ventral valve, from the mesial sinus to the lateral extremities, and its sharply defined mesial sinus, and cardinal area, as well as the narrowness and abrupt elevation of its mesial ridge. All of these characters, it is true, occur in other species, but not, so far as we have been able to find, all combined in any one species agreeing with this in form, surface-markings, and other respects. *S. varicosus*, Hall (Ann. Report Regents Univ., N. Y., for 1856, p. 130, 1857), for instance, seems, judging from the description alone, for we have not yet seen that shell or a figure of it, to be quite similar, and yet differs in sometimes having a plication in the mesial sinus; and particularly in having the surface "marked by regular distinct imbricating lines of growth, which sometimes give a subnodose character to the plications." It is true most of our specimens have the surface exfoliated, but one of them shows the orginal surface of the plications to be without any such markings.

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*The mesial ridge is not correctly represented in fig. 6 *d*, not being prominent enough; while the appearance of a plication on its right side is a defect in the shading. It is also represented too wide and too round on top in fig. 6 *a*.

The internal casts represented by figures 7 *a*, *b*, pl. 8, were found in the same horizon, and may belong to the same species, though we are not sure they do, as their plications are larger, and the impression of the area in the matrix (see 7 *a*, *b*) shows it not to be so high, and considerably more inclined back over the hinge.

*Locality and position:* Cherty Limestone of the age of the Oriskany Sandstone of the Devonian series, at several localities in Union county, Illinois. The casts 7 *a*, *b*, however, are from the same horizon in Alexander county.

## GENUS RENSSELÆRIA, Hall, 1859.

(Regents' State Cab. N. H. Report, p. 39.)

### RENSSELÆRIA CONDONI, McChesney.

Pl. 8, fig. 4 *a*, *b*.

*Rensselæria Condoni*, McCHESNEY, 1861. Palæozoic Fossils, p. 85.
*Rensselaria Condoni*, McCHESNEY, 1865. Explanations of pl. vii, Palæozoic Fossils (fig. 2)
*Rensselæria Condoni*, McCHESNEY, 1867. Trans. Chicago Acad. Sci., vol. I. p. 36, pl. vii, fig. 2.
Compare *Meganteris ovalis*, HALL, 1857. Regents' Report for 1856, p. 101; —*Rensselæria ovalis*, of same, Third vol. Palæont. N. Y., p. 458, pl. cvi, fig. 2 *a*–*l*.

SHELL compressed, sublenticular, broad-oval or subcircular in outline, the length but slightly exceeding the breadth, widest near the middle; sides and front rounded, the latter more narrowly; lateral margins truncated, and inflected at right-angles to the plane of the valves. Ventral valve a little more convex than the other; beak projecting a little beyond that of the other valve, incurved, and having its lateral slopes rather angular, so as to give somewhat the appearance of there being a cardinal area. Dorsal valve slightly and evenly convex. Surface apparently smooth. Internal characters as in *R. ovalis*. Punctate structure readily seen by the aid of a pocket lens.

Length and breadth of the largest specimen seen, 1.10 inches; convexity, about 0.38 inch. Other individuals proportionally a little larger.

We have seen no good specimens of this shell; but a few of those obtained since plate 8 was engraved, are in a much better condition than those figured. So far as we have yet been able to see, it seems to agree in all respects with *R. ovalis*, Hall, excepting that none of the specimens show any traces of radiating striæ. It should be remembered, however, that all of the few examples yet obtained, were broken from a hard matrix, and have the surface badly preserved; while New York specimens of *P. ovalis*, in the same condition, often show no remains whatever of striæ. One of the latter now before us, from Schoharie, New York, shows no traces of radiating striæ, and agrees well with those under consideration. We are nearly satisfied in regard to the specific identity of the Illinois shell with *R. ovalis*, but prefer to retain for it the name *R. Condoni*, until we can have more satisfactory means of deciding whether it is distinct or not.

*Locality and position:* Cherty limestone of the age of the Oriskany sandstone of the New York Devonian; on Clear creek, and other localities west of Jonesboro, Union county, Illinois.

## Genus STRICKLANDINIA, Billings, 1863?*

(Canad Nat., vol. VIII., p. 370.)

### Stricklandinia elongata, var. curta.

Pl. 8, fig. 1 *a*, *b*, *c*, and pl. 9, fig. 5?

*Pentamerus elongatus*, Vanuxem, 1842. Geological Report Third District N. Y., p. 132, fig. 1; Hall (1843), Geol. Report Fourth District N. Y.. No. 34, fig. 4.

*Meganteris elongatus*, Hall, 1837. Tenth Ann. Rep. Regents Univ. N. Y., p. 128.

*Rensselaria elongata*, Hall, 1859. Twelfth Ann. Rep. Regents Univ. N. Y., p. 88.

*Stricklandia elongata*, Billings, 1861. Devonian Fossils Canada, p. 58, fig. 91 and 92.

*Stricklandinia elongata*, Billings, 1863. See Davidson's Monogr. Brit. Sil. Brach. (1867), part VII, No. ii. p. 157.

Shell obovate, subequivalve, in a majority of specimens not more than one-fourth to one-third longer than wide, the widest part being behind the middle; in young individuals moderately gibbous, but becoming extremely so in large adults, which are in some examples about one-eighth more convex than wide; greatest breadth and convexity behind the middle; sides truncated and flattened (or even a little concave) at right-angles to the plane of the valves, the flattened or concave space being widest in gibbous examples, which present a subhexagonal outline, as seen in an end view (fig. 1 *c*, pl. 8); hinge margin rounding off laterally from the beaks in testiferous specimens, but generally somewhat straightened in internal casts; front narrowly rounded. Dorsal valve a little less convex than the other, being most prominent along the middle, on each side of which its slopes are a little flattened to the truncated lateral margins; beak incurved; ventral valve, with much the form of the other, excepting the slightly greater convexity and more prominent beak, which is sometimes pointed at the apex, and strongly curved over and upon that of the other valve. Surface nearly smooth, with a few obscure wrinkles, or marks of growth, towards the front of adult specimens.

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* Mr. Billings first described this genus under the name *Stricklandia*, in 1859; but on learning, at a later date, that this name had been previously used for a genus of plants, he proposed the name *Stricklandinia* for the genus of shells.

Length of the largest individual seen (internal cast), 1.92 inches; breadth, 1.30 inches; convexity, 1.47 inches.

Internal casts of this species show that the chamber in the beak of the ventral valve is well developed, moderately large, and triangular. In the dorsal valve there were two short, closely approximated plates, united at the bottom of the valve, and supporting at their inner edges the internally produced crura. In most of the casts of the dorsal valve the two short plates are as well developed as we sometimes see in true *Pentamerus*, and evidently inclosed a narrow chamber that extended along the bottom of the valve. In this character of the dorsal valve these shells differ from the typical forms of the genus *Stricklandinia*, and in this and other characters resemble *Pentamerus* so closely that we should have doubted the propriety of referring them to any other genus, were it not that our specimens show the shell structure to be distinctly punctate. The punctures are easily seen with a common hand lens, and are very regularly and closely arranged. We are not aware whether in any of the typical species of *Stricklandinia* the punctate structure has been observed; though from the analogy of that type to *Rensselæria*, it probably has the same shell structure.*

In regard to the specific relations of our shell to *S. elongata*, of Vanuxem, we are in considerable doubt. The fact that we only know that shell from the figures of two individuals (Vanuxem's original type, and one figured by Mr. Billings), representing the exterior of the shell, while our specimens are mainly internal casts, renders our comparisons very unsatisfactory. All four specimens, however, differ from both of the figures alluded to, in being widest *behind* the middle. They are all likewise smaller than the New York and Canadian examples figured, and with the exception of the specimen from which our figures 1 *b* and 1 *c* were drawn, much shorter in proportion to their breadth, a majority of them not being more than about one-fifth longer than wide, and others even proportionally shorter. The young shell was quite as wide as long. It is probably a distinct species, but we prefer to regard it as a variety of that form (*elongata* is said by Mr. Billings to be quite variable) until we can have more satisfactory means of comparison.

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* Since this was written, we observe Prof. Hall proposes (Regents' Twentieth State Cab. N. H. Report, p. 163) to separate the New York species, *Pentamerus elongatus*, of Vanuxem, from *Stricklandinia*, of Billings, under the name *Amphigenia*, in consequence of its want of a cardinal area, and the possession of a punctate structure. Should this separation be sustained, and our shell prove to be specifically distinct from the New York form, it will have to take the name *Amphigenia curta*.

*Locality and position:* Cherty limestone of the age of the Oriskany sandstone of the New York Devonian series; Union county, Illinois. Smaller casts, possibly of the same species, also occur in the overlying sandstone at the same locality. In New York the species *elongata* occurs in the Onondaga limestone, but in Canada it is also found in the Oriskany sandstone and Corniferous limestone.

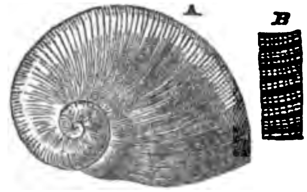
# GASTEROPODA.

## GENUS STROPHOSTYLUS, Hall, 1859.

(Regents' State Cab. N. H. Report, p. 21.)

### STROPHOSTYLUS? CANCELLATUS, M. and W.

Pl. 8, fig. 12 (and 11 *a*, *b*?)



*Strophostylus? cancellatus.*

Fig. A, view of upper side of a nearly perfect specimen.

Fig. B, enlargement of surface markings of same.

SHELL depressed, obliquely oval, height about two-thirds the breadth; spire depressed nearly upon a level with the body whorl; volutions three, increasing very rapidly in size, generally wider than high; last one very large and ventricose, lapping a little upon the others at the suture above, and flattened or slightly concave near the aperture just outside of the suture, which is merely linear; aperture large, sub-orbicular; outer lip thin, very oblique, meeting the volution above nearly at right angles, and extending very much farther forward above than the lower margin of the aperture. Surface ornamented by fine, rather distinct, lines of growth, starting from the suture at first, slightly forward, but immediately curving very obliquely backwards as they extend outwards, and pass over the rounded outer side parallel to the oblique margin of the lip; crossing these there are also finer raised revolving lines, which become more widely separated, and less distinct or even obsolete on the body volution as they approach the aperture.

Height of the most nearly perfect specimen seen, 0.75 inch; breadth, 1.20 inches.

At first we were inclined to regard this as a *Platyceras*, allied to *P. ventricosum*, or *P. Gebhardi*, but some better specimens, obtained since the figures on plate 8 were drawn, show that the body volution does not become free at the aperture, and that there is a columella. None of them, however, are in a condition to show very clearly whether the columella has the peculiar twisted character of *Strophostylus*, though we think we have seen some evidences that it has. The figures on plate 8 were unfortunately drawn from internal casts (the best we had at that time), and do not convey a very clear idea of the shell. Those retaining the shell (one of which is represented by the foregoing cut) show that the volutions do not round into the suture above, but lap upon the next volution within, so as to leave merely a linear suture. This character, together with a slight concavity, or flattening of the upper side of the body whorl near the suture, and the remarkable obliquity of the lines of growth and the margin of the lip, give the shell very much the appearance of a *Lunatia* or *Neverita*, as seen from above.

Our description is drawn up from the best testiferous specimen represented by the annexed wood cut It is probable these smaller specimens are distinct from that represented by figures 11 *a*, *b*, which has the body whorl more ventricose, and prominent below, and not increasing quite so rapidly in breadth. There are, however, some associated smaller specimens, having the same form as that represented by figure 11, showing exactly the same surface markings seen on that from which the foregoing description was made out. Should these less depressed and more ventricose forms, such as that represented by figures 11 *a*, *b*, prove distinct, they may be called *S. ventricosus*.

We should explain here that the striæ seen on fig. 11 *b*, were intended, in the drawing, to represent faint traces of marks of growth seen on the internal cast, but in the engraving they are made too sharp, so as to look like surface striæ, for which, however, they do not curve as much as they should, and are not near oblique enough, particularly on the right lower side of the figure.

*Locality and position:* The large specimen (fig. 11) is from the light-gray subcrystalline limestone at Bald Rock, Jackson county, Illinois, of the age of the Oriskany Sandstone of the New York Devonian series. Smaller specimens of the same form also occur, with the more depressed form represented by fig. 12, at the same horizon at Bald Knob, Union county.

## GENUS PLATYCERAS, Conrad, 1840.*

(Ann. Rep. Palæont. N. Y., p. 205.)

### PLATYCERAS SPIRALE, Hall?

Pl. 8, fig. 10.

*Platyceras spirale*, HALL, 1859. Palæont. N. Y., vol. III, p. 331, pl. lxiii, fig. 4–9.
Compare *P. tortuosum*, HALL; ib. p. 472, pl. cxiii, fig. 1–5.

IN regard to the relations of this shell to *P. spirale*, we can only say that the few imperfect specimens we have yet seen show no reliable characters by which it can be certainly distinguished. It is not improbable, however, that a good series of well preserved specimens might prove it to be entirely distinct, since the identification of species in a genus like this, from a few fragmentary specimens, is of course very far from satisfactory.

It was evidently a slender, elongated, tortuous, rather thick shell, more or less expanded at the aperture. It generally shows no plications, and has but faint indications of lines of growth, on the remaining portions of the shell. The only larger individuals in the collection, like that from which fig. 10 was drawn, have all had the upper part of the spire broken away. A smaller specimen, however, from the same locality and position, probably belonging to the same species, shows some obscure indications of a few irregular longitudinal plications, crossed by undulating lines of growth, and has its immediate apex spiral, as in some examples of *P. spirale*.

The only reasons why these shells might not, upon quite as good grounds, be referred to the New York Oriskany Sandstone species, *P. tortuosum*, are the more expanded character of the aperture of the larger specimen, and the spiral apex of the smaller one. It is worthy of note however, that only one of the figured specimens of *P. tortuosum* has the apex of the spire preserved, and *it* is only an internal cast. Indeed it must be confessed, that in regard to the distinctions between the figured specimens of *P. spirale* and some of those referred to *P. tortuosum*, not very much can be said; and had some of the latter been found associated in the same bed with the typical examples of *P. spirale*, few would ever suspect them to be distinct. The fact that *P. spirale* is a Lower Helderberg species, and that *P. tortuosum* occurs in the Oriskany Sandstone, cannot, alone, be relied upon to prove them to be distinct, especially when several species of other genera, and one of this (*P. Gebhardi*), are acknowledged to be common to both of these horizons.

*Locality and position:* Bald Rock, Jackson county, Illinois; from Cherty light-gray limestone, belonging to the horizon of the Oriskany Sandstone of the New York Devonian series.

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* For remarks on this genus see page 384.

# FOSSILS OF THE CORNIFEROUS GROUP.

# RADIATA.

## ZOOPHYTA.

### GENUS PLEURODICTYUM, Goldfuss, 1829.

(Petref. Germ., vol. I, p. 113.)

### PLEURODICTYUM PROBLEMATICUM, Goldf.?

Pl. 9, fig. 1 *a*, *b*, *c*.

*Astroita*, PETER WOLFART, 1719. Hist. Nat. Hass. infer., p. 30, tab. 25, fig. 5; LIEBKNECHT, 1759, Hass. Subterr., tab. 2, fig. 4.

*Corps particuliers*, etc., KNORR et WALCH, 1775. Rec. des mon. des Catastr., t. III, p. 199, supp. pl. 10*b*, fig. 1, 2, 3.

*Pleurodictyum problematicum*, GOLDFUSS, 1829. Petref. Germ., t. I, p. 113, pl. 38, fig. 18; BRONN (1835–37), Leth. Geog., t. I, p. 56, tab. 3, fig. 12; PHILLIPS (1841), Palæozoic Foss., p. 19, pl. 9, fig. 24; DEVERNEUIL et HAIME (1851), Bull. Geol. Soc. Fr., t. VII, p. 164; EDWARDS and HAIME (1845), Arch. Mus., t. V, p. 210, pl. 18, fig. 3, 4, 5, 6.

CORALLUM depressed, subhemispherical, or semilenticular; concavo-convex, the under side being concave and provided with an epitheca, and the upper convex. Corallites somewhat irregular in size and form, more or less angular, often hexagonal, short, increasing rapidly in size, and so distinctly radiating from the middle upwards and outwards, that the lower series lie nearly or quite parallel to the concave base, and even decline as they extend out from near the middle to the periphery—those rising from near the middle, shorter than the others; connecting pores, as indicated by their casts, rather numerous, and apparently irregularly arranged, sometimes passing through the corners as well as the sides of the walls between the corallites.

Breadth of the largest specimen seen, 1.38 inches; height, 0.40 inch.

Our specimens of this coral agree so nearly with some of Edwards and Haime's figures of *Pleurodictyum problematicum*, that we have concluded to refer it provisionally to that species, without being quite convinced of its exact specific identity. Edwards and Haime's figures 4 and 4 *a*, of the plate cited in the synonymy, seems to agree exactly with our specimens in all respects; but their figure 5, representing a vertical section, shows the corallites less spreading than in our specimens, in which the lower series radiate horizontally, or even decline a little at the periphery. Nor do any of our specimens show the casts of distinct striæ or septa on the inner walls of the corallites, as seen in some of Edwards and Haime's figures; though in this respect they agree quite well with others of their figures. None of our specimens show any traces of the peculiar Serpula-like tube sometimes seen within European specimens of *P. problematicum*, but as this is not always present in the typical examples, we agree with those who regard it as the work of some boring, tube-secreting animal, and not a part of the coral itself.

It will be observed that Edwards and Haime's figure 5, as well as Goldfuss' figure 18 *b*, pl. 38, represent the base of *P. problematicum* as having the epitheca smooth, excepting very distinct concentric striæ or wrinkles of growth; while figure 4 of the former authors, represent its cast as being marked with numerous small pits, apparently left by distinct granules, on the under side of the epitheca, without any traces of concentric wrinkles. Our specimens agree with the latter, where well preserved, and none of them show any indications of concentric markings. We are at a loss to account for these differences in the different European specimens. At first we were inclined to think the pitted appearance might have been produced by the connecting points of the bases of the corallites on the *inner* side of the general base, and that the concentrically wrinkled specimens showed casts of the *under* or *outer* side of the epitheca. The fact, however, that the little pits are greatly more numerous than the corallites, and can be seen in our specimens under the *sides* of the lower horizontally arranged corallites, are sufficient evidences that they were not produced by their starting points.

Dr. Rominger has ingeniously suggested that *Pleurodictyum* (which is only known as casts), is really only the cast of a *Favosites* (Am. Jour. Sci., vol. XXXV, p. 82), and we are by no means satisfied that he is not correct. Indeed our first impression in regard to our specimens, before we thought of comparing them with *Pleurodictyum*, was that they were cases of a small species of *Favosites*. On comparing them with Edwards and Haime's figures of

*P. problematicus*, however, we were at once satisfied that they must belong to the same genus, if not indeed to the same species.

After a careful study of our specimens, we can see but one objection to Dr. Rominger's view. That is, that in looking in between the lower side of the lower horizontally extended corallites, and the cast of the pitted base, we can see numerous little bars passing across this thin space (evidently occupied in the perfect fossil by the thin common base), exactly like those passing across between the corallites. As the latter must be the casts of little pores connecting the corallites, as seen in *Favosites*, their presence between the under sides of the casts of the lower corallites, and that of the lower surface of the base, would also indicate the existence of numerous pores passing *through the base*, a character, we believe, not yet known to exist in *Favosites*. Still it is worthy of note that no pores are represented in Goldfuss' or Edwards and Haime's figures, showing the wrinkled exterior of the base of *Pleurodictyum*.

Our figures are defective in not showing numerous little projecting points (casts of pores) all over the casts of the corallites, as well as those passing across between them. Generally these are broken off, but their remains can be usually seen, on a careful examination, on all sides. The casts being in rough sandstone, the casts of the pores are not readily distinguished from the general granular appearance of the matrix.

*Locality and position:* Yellowish friable sandstone, referred to the horizon of the Onondaga period of the New York series; four miles west of Jonesboro, Union county, Illinois.

## GENUS BARYPHYLLUM, Edwards and Haime, 1850.

(Brit. Foss. Corals, p. lxvi.)

### BARYPHYLLUM?? ARENARIUM, M. and W.

Pl. 9, fig. 2 *a*, *b*.

As is the case with all the other fossils yet obtained from the same bed, we only know this coral from moulds left in the sandstone matrix. They were evidently compressed or discoidal, with an oval or more or less nearly circular outline; and all appear as if about one-half of the upper side had been slightly concave, and the other convex. Several of them show some indications of a faintly impressed fosset (an obscure ridge in the mould) in the concave half, while in other instances there would seem to have been a ridge there, that left a *furrow* in the mould, as is seen extending up from the middle to the top of fig. 2 *b*. This, however, is much too strongly defined in the figure, being in the specimen merely a very shallow furrow, without well defined edges. Some specimens, such as that represented by fig. 2 *a*, show no traces of this fosset in the mould of the concave half. In the impression of the convex half, they all seem to have had a ridge or larger septum extending from the middle to the margin, on a line with and directly opposite the fosset mentioned. This is seen on the lower half of figure 2*b*, where it appears as a furrow in the mould. The rays are obscure and numbered from about sixty-eight to eighty, those in the concave half being generally smaller and more closely arranged than the others.

Of course, we are by no means sure this coral belongs to the genus *Baryphyllum*, but we merely refer it provisionally to that group, until specimens can be obtained showing more clearly its characters. Probably we should call it *Combophyllum arenarium*; but we rather incline to the opinion that it will not properly fall into any of the established genera.

*Locality and position:* Same as last.

## GENUS ZAPHRENTIS, Raf. and Cliff., 1820.

(Ann. Gen. des sc. Phys. de Bruxelles, t. V, p. 234.)

### ZAPHRENTIS (sp. undt.)

Pl. 9, fig. 3 *a*, *b*.

ALL the specimens of this fossil yet found in this rock are merely casts of the calices, and of course do not retain enough of the characters of the species to enable us to make satisfactory comparisons, or to characterize it fully. It was evidently rather under medium size, and provided with a moderately deep calice, and a well defined fosset. The impressions show the septa to have been rather stout, somewhat twisted towards the middle of the cup, and numbering about 50 to 60 principal ones, with shorter ones below.

*Locality and position:* Same as last.

# MOLLUSCA.

## BRACHIOPODA.

## GENUS ORTHIS, Dalman, 1828.

(Uppstalln., p. 110.)

### ORTHIS (undetermined).

Pl. 9, fig. 4.

THIS species has the general appearance, in the condition of an internal cast, of *O. musculosa*, Hall, but is much smaller. As we have only a cast of the dorsal valve, however, we have not the means of arriving at a satisfactory conclusion in regard to its relations. It is very convex, or nearly hemispherical, (its outline being nearly circular) and shows short impressions of regular striæ around the margins, and a prominent conical cardinal process at the beak.

Length, 0.87 inch; breadth, 0.93 inch; convexity of dorsal valve, 0.33 inch.

*Locality and position:* Same as last.

## GENUS STROPHOMENA, Raf., 1820.

(*Strophomenes*, Raf.; *Strophomena*, Blainv. (1825), Mal., p. 513.)

### STROPHOMENA (STROPHODONTA) sp.?

Pl. 9, fig. 9, (and 7 *a*?)

SHELL small, very convex, or exclusive of the ears, subhemispherical; length and breadth nearly equal; hinge line finely crenate, usually slightly longer than the breadth of the valve at any point in front of it, and terminating in rather distinct angles, in consequence of the sinuous character of the posterior lateral margins; front regularly rounded. Ventral valve very gibbous; beak curved, area of moderate breadth. Surface of internal cast showing remains of rather coarse radiating striæ.

Length, 0.54 inch; breadth (on hinge), 0.58 inch; convexity, 0.24 inch.

A single impression, in the same matrix, of the interior of a dorsal valve (represented by fig. 7 *a*), of the same size and form, at first supposed to belong to another species, probably belongs to this. This valve was evidently nearly flat, or a little concave on the outside, excepting around the free border, which was deflected upwards. It shows the impression of a small mesial ridge, and a small muscular scar on each side of it, while the bifid cardinal process is moderately prominent.

Figure 7 *b*, from the same locality and position, may possibly be a cast of the exterior of the dorsal valve of the same species. It differs, however, in being a little convex on the outside, and shows no indications of the upward deflection of the margin. Figure 8, also from the same matrix, represents a cast of the exterior of a nearly flat valve, apparently belonging to a distinct, more coarsely and unequally striated species, less extended on the hinge, and resembling a young *Hemipronites crenistria*.

Without more and better specimens of these little shells (those we have seen are mere casts in sandstone) for comparison, it seems scarcely possible to arrive at very satisfactory conclusions respecting their relations to each other, and to the described species. Consequently we have concluded not to attempt to name any of them as new species, at present.

*Locality and position:* Same as last.

### STROPHOMENA (STROPHODONTA), (sp.)

Pl. 6, fig. 6 *a*, *b*.

As we have only seen casts of this shell, in friable sandstone, we have not felt warranted in identifying it with any of the known species, and for the same reason we can not be quite sure that it is new. It is much compressed, wider than long, and usually has the hinge line a little shorter than the greatest breadth of the valves near the middle, though the posterior lateral extremities are rather distinctly angular. The surface of both valves is marked by very fine, angular, radiating, crowded striæ, (more curved on the lateral region than represented in figure 6 *b*), and crossed by about two or three widely distinct subimbricating marks of growth.

*Locality and position:* Same as last.

## GENUS PRODUCTUS, Sowerby, 1814.

(Min. Conch., vol. I, p. 153.)

### PRODUCTUS EXANTHEMATUS, Hall ? ?

Pl. 10, fig. 8 *a*, *b*, *c*.

*Productus exanthematus*, HALL, 1857. Tenth Ann. State Cab. N. H. Report Regents University of New York, p. 174.

SHELL very small, wider than long, semioval in outline, very convex; hinge about equaling the greatest breadth; anterior and anterio-lateral margins forming a regular semicircular curve. Ventral valve strongly arched from beak to front; umbo rather gibbous and incurved; ears small, generally nearly rectangular, and not very distinct from the slope of the umbo; surface ornamented with more or less elongated tubercles, sometimes assuming the character of little irregular ribs, some of which evidently bore spines that were comparatively long and erect; very minute concentric striæ are also seen by the aid of a magnifier on well preserved surfaces. Dorsal valve moderately concave, and showing obscure, irregular, elongated pits, instead of tubercles, and marked with the same minute concentric striæ seen on the other valve.

Length of largest specimen, 0.40 inch; convexity, 0.25 inch.

We are far from being satisfied that this is the species described by Prof. Hall, since it is next to impossible to form any very satisfactory conclusions in regard to the characters of a species in a genus like this, from a two and a half line description of a single dorsal valve, without a figure or measurements by which we can have any idea even of its size. We are led to suspect, however, that our shell *may* possibly be the same, because Prof. Hall says he thinks his species probably identical with a form found at the "Bake-oven," on the Mississippi, in this State, that was identified with *P. subaculeatus*, by Norwood and Pratten, since, on comparing our shell with specimens of the latter from that locality, we can see no essential difference, excepting that some of the "Bake-oven" specimens are nearly twice as large as those under consideration.

It is quite probable that this shell is not distinct from some of the European forms sometimes referred to *P. subaculeatus*; but we do not believe it identical with that species, as figured and described by Mr. Davidson, in his Monog. Brit. Devonian Brachiopoda, part VI, pl. xx, fig. 1 and 2, from which it differs not only in being much smaller, but in being proportionally more convex, and in having its tubercles more distinctly elongated into ribs.

The engravings of our shell on plate 10 are defective in making the tubercles look like little round spine bases, instead of elongated tubercles, sometimes assuming the characters of ribs, while the radiating lines seen extending up to the beak, on fig. 3 *a*, do not exist on the fossil. The two straight spines extending from the left ear of fig. 3 *c*, seem rather to belong to another specimen of the same species, lying in the matrix immediately along side (but not represented in the figure).

*Locality and position:* The specimens figured are from a light-gray, rough-fractured, silicious limestone, two miles west of Jonesboro, Union county, Illinois; believed to be of the age of the Corniferous or Onondaga division of the New York Devonian series. Larger specimens of apparently the same species occur in the Hamilton beds, at the "Bake-oven," on the Mississippi, in Jackson county, Illinois.

## GENUS SPIRIFER, Sowerby, 1815.

(Min. Conch. II, p. 42.)

### SUBGENUS TRIGONOTRETA, Kœnig, 1825.

### SPIRIFER PEREXTENSUS, M. and W.

Pl. 10, fig. 1 *a*, *b*, *c*, *d*.

SHELL greatly extended transversely, or about four times as wide as long, rather compressed or but moderately convex, subequivalve; anterior lateral margins straight or nearly so; hinge line equaling the greatest breadth; lateral extremities produced and acutely pointed. Ventral valve a little more convex than the other; beak not very prominent, and but little arched; area rather narrow (wider, however, at the beak than represented by figure 1 *c*), becoming very narrow, with nearly parallel sides, towards the lateral extremities, and arching a little in the region of the beak; mesial sinus commencing very narrow at the beak, and widening and deepening regularly to the front, rounded and smooth within, and sharply defined by the marginal plication on each side; lateral slopes nearly straight, or a little convex from the mesial sinus to the extremities, but regularly arched from the hinge to the front, each ornamented by from 18 to 24 simple, regular, somewhat rounded plications, more than half of which are directed so that if produced they would not reach the beak, but intersect the hinge line, near which they become obsolete. Dorsal valve less convex in the umbonal region than the other, beak moderately incurved, area distinctly narrower than in the other valve; mesial fold very narrow near the beak, rather depressed and flattened, or even a little concave along the middle, with nearly vertical sides; lateral slopes slightly concave on a line from the mesial ridge to the lateral extremities, and ornamented with ribs as in the other valve. Surface with rather obscure marks of growth, somewhat undulated in crossing the costæ, and more distinctly defined in the mesial sinus and upon the mesial fold.

Length, 0.90 inch; breadth, about 3.56 inches; convexity, about 0.60 inch.

This seems to be one of the most extremely transverse species of the genus, and in this respect resembles *S. pinnatus* of Owen, particularly the variety for which he proposed the name *S. ligus.* It is more transverse in proportion to length, however, and not so convex. Its area is also less developed, its anterior lateral margins straighter, and its mesial fold flattened or concave on top, instead of rounded. We have likewise been unable to see on our shell any traces of the fine radiating striæ seen on Dr. Owen's species, though it is possible better specimens might show them. Even then, however, the other differences would readily distinguish the two shells.

It is more nearly related to *S. paradoxus*, Schlot, (sp.), and may possibly be identical with that species, or at least with some of the forms that have been referred to it. It differs from Quenstedt's figure of that species (Hanb. der. Petref. tab. 38, fig. 18), however, very decidedly, in having much more numerous and smaller costæ; while its anterior lateral margins, as shown by the marks of growth, were always much straighter in outline. It nevertheless agrees much more nearly, in these respects, with an Eifel form figured by Schnur (Palæontographica III, tab. xxxii *b*), under the name *S. paradoxus*, but has the plications smaller on the central region, and its area proportionally higher near the beak; while its decidedly flattened mesial fold gives it a very different appearance.

*Locality and position:* Same as last.

## SPIRIFER PARADOXUS, Schlot. ?? (sp.).

Pl. 10, fig. 2.

*Terebratulites paradoxus*, SCHLOT. 1813. Im Taschenb. VII, tab. 2, fig. 6; Petref. 1, 249.
*Spirifer paradoxus*, QUENST. 1852. Handb. Petref., 478, t. 38, fig. 18; SCHNUR, 1854, Palæontographica, III, p. 198, tab. xxxii *b*, fig. 1 *a*, *b*, *c*; ? DAVIDSON 1864, Monogr. Brit. Devonian Brachiopoda, pl. viii, fig. 11 and 13.

WE have seen but one specimen of this form, and it only consists of an internal cast of a ventral valve, with part of the shell remaining on the right side. It differs from the last in not having so many, nor so large plications, which are also less prominent, and more roughened by the marks of growth. Its mesial sinus is likewise deeper and more angular in the middle, and less sharply defined on each side. It may possibly be a variety of the last, though it would be readily distinguished by its larger ribs from any of the specimens of that form we have yet seen.

It agrees more nearly with the published figures of *S. paradoxus*, but the form of its rostral cavity, as indicated by the internal cast, is unlike that of

*S. paradoxus*, as illustrated by Quenstedt and Davidson. In this, as well as most of its other characters, however, it seems to agree more nearly with Schnur's figure of casts of that shell, given in the Palæontographica.

Length, 0.95 inch; breadth, 3 inches; convexity of ventral valve, 0.40 inch.

*Locality and position:* Same as last.

# ARTICULATA.

## *CRUSTACEA.*

### GENUS DALMANITES, Auct.

*Dalmania*, EMMRICH, 1845 (not Rob. 1830),—*Odontochile*, CORDA, 1847, (not Lap. 1834).

### SUBGENUS ODONTOCEPHALUS, Conrad, 1840.

(Ann. Rep. Palæont. N. Y., p. 204.)

ALTHOUGH this type is generally regarded as not being distinct from *Dalmanites*, it seems to us to present sufficiently well marked distinctive characters to rank at least as a good subgenus, if not indeed as a well defined genus. The fact that the peculiar perforated expansion of the anterior margin of the head seems to be always coexistent with the bifurcated character of the caudal extremity in these trilobites, certainly seems to indicate fundamental differences in the structure of other parts of the animal, from the typical forms of *Dalmanites*, in which neither of these characters exist. In addition to this, the fact that there is a *group* of species presenting these characters, also favors the same conclusion.

Our specimens show clearly that the extended border of the anterior margin of the head is really *perforated* by oblong, or elongate-oval, isolated openings, passing entirely through, and not merely provided with ridges and depressions, or divided by deep sinuses, extending in between tooth-like projecting processes, as has been supposed to be the case with some of the N. Y. species. Some species, however, *may* possibly have the margin not quite continuous between the bars separating these perforations, but we doubt whether this is the case in any but specimens that have had the margin broken away.

### ODONTOCEPHALUS ——— ?

Pl. 9, fig. 10.

OF this trilobite we have merely impressions in the sandstone matrix, of the expanded and perforated anterior margin of the head. These show it to have attained a large size. It evidently differs from the form found in the limestones above and below the sandstone in which it occurs, in having but ten of the elongated perforations of the alate anterior margin of the head (which are also more widely separated), instead of twelve, as well as in having this part much more broadly rounded in outline. As the specimen figured represents only the alate margin, it is probable that if the posterior angles of the cheeks were produced backwards into spines, that they extended farther even than indicated by the dotted lines, and that the whole animal may have been near five inches in length.

In the number of perforations passing through the alate anterior margin, it agrees with *O. selenurus*, of Conrad, but it seems to differ in the greater breadth and outline of this part, and probably attained a larger size. It may possibly be identical with some of the species indicated from the Lower Helderberg rocks of New York, and not yet figured, but we are inclined to believe it new. If so, it may be called *Dalmanites* (*Odontocephalus*) *arenarius*.

*Locality and position:* Four miles west of Jonesboro, Union county, Illinois; in a friable sandstone apparently occupying the horizon of the Onondaga or Corniferous beds of the N. Y. Devonian.

### DALMANITES (ODONTOCEPHALUS) ÆGERIA, Hall? (sp.)

Pl. 10, fig. 4 *a*, *b*, *c*.

*Dalmania ægeria*, HALL, 1861. Fifteenth Ann. Rep. Regents Univ. N. Y., p. 85.

CEPHALIC shield semielliptic, moderately convex, with the posterior lateral angles produced backwards into long acutely pointed spines; anterior margin produced and narrowly rounded in outline, its perforated border wide, or measuring about two-sevenths the entire length of the head, from the front to the posterior margin of the occipital ring, and provided with twelve narrow-oval perforations, gradually decreasing in length posteriorly, and separated by eleven narrow bars, the middle one of which is longest. Glabella separated from the cheeks by well defined furrows; anterior lobe subrhomboidal, and wider than long; anterior lateral lobe a little longer than either of the others behind it; furrows between them all, excepting the anterior ones, transverse, narrow, and none of them extending entirely across; neck furrow, and its continuations across the posterior margins of the cheeks, well defined; eyes prominent, somewhat reniform, as seen from above, placed less than their own antero-posterior diameter in advance of the posterior margin of the cheek, provided with about twenty-five lenses in the row around the lower margin; cheeks sloping off abruptly from the eyes (in internal casts) to a broad, well-defined furrow, extending around to the lateral margin of the anterior lobe of the glabella.

Pygidium subtrigonal, rather depressed; lateral margins a little concave in outline behind; divisions of its posterior extremity short, parallel, and so closely approximated that the sinus between them is scarcely wider than one of the divisions; mesial lobe but little more convex than the lateral, and distinctly narrower, well defined by the furrow on each side, and showing about ten or eleven distinct segments, with space enough behind for three or four more; lateral lobes with each nine or ten segments, the posterior one being small, and directed nearly backwards; margins beyond the segments narrow and sloping.

The specimens of this form we have seen consist only of the head and pygidium. The former are mainly casts, with some portions of the crust remaining. None of the specimens of the pygidium we have seen seem to be quite large enough to belong to the same individuals as the larger heads, though from their constant association, we can scarcely doubt that they belong to the same species. The surface of the pygidium is very finely and obscurely granular; while the casts of the head show indications of rather coarse granules or small pustules on the anterior lobe of the glabella.

As no figures of *O. ægeria* have yet been published, we can not be quite sure that our specimens belong to that species. As far as the characters of the form under consideration are known, it seems to agree so nearly, however, that we are very much inclined to believe it the same, though it is quite possible a comparison of specimens might show them to be distinct.

The specimen from which our figure 4*a* was drawn is mainly a cast somewhat distorted by pressure, though it is made to appear too flat in the figure. The segments in the lateral lobes of figures 4*b* and 4*c*, are also erroneously carried quite out to the margin. The margin extends a little beyond the terminations of the furrows between the segments, in the form of a narrow, smooth border.

*Locality and position:* Light-gray subcrystalline limestone, of about the age of the Corniferous division of the New York Devonian series; four miles west of Jonesboro, Union county, Illinois. It also occurs at a lower horizon in a similar limestone, believed to belong to about the position of the New York Oriskany sandstone, one mile east of Bald Knob, Union county, Illinois.

# FOSSILS OF THE HAMILTON GROUP.

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# PROTOZOA.

## SPONGIÆ.

### GENUS ASTRÆOSPONGIA, Roemer, 1854.

### ASTRÆOSPONGIA HAMILTONENSIS, M. and W.

Pl. 10, fig. 6.

*Astræospongia Hamiltonensis*, MEEK and WORTHEN, 1866. Proceed. Chicago Acad. Sci., vol. 1, p. 12.

WE merely know this species from a biscuit-shaped nodular mass, showing on one side numerous six-rayed calcareous stars, 0.13 inch in diameter, measuring across from the extremities of the opposite rays. The specimen is not in a condition to show the general form of the whole body, if freed from the matrix, but as near as can be determined it seems to have been of a discoid or compressed, subglobose form. The star-like spicula agree so exactly in form, size, and their mode of aggregation, with those of *Astræospongia meniscus* of Roemer, from the Upper Silurian beds of Tennessee (Sil. Fauna West Tenn., p. 14, pl. i, fig. 6 *a–d*), that we confess we can see no difference whatever between them, as seen in our specimen, and represented in Roemer's figures. From their different geological positions, we were led to infer, that if we could compare perfect specimens of each, good specific differences would probably be observed; still it may not be really distinct.

Our specimen measures 2.50 inches in its greater diameter, and about 1.20 inches in thickness, though the peculiar star-like structure does not pervade the whole mass, particularly its entire thickness. The thickness of each individual ray of the stars is about 0.02 inch, and their length 0.06 inch. They are invariably six-rayed.

*Locality and position:* New-Buffalo, Iowa; Hamilton division of the Upper Devonian.

# RADIATA.

## ZOOPHYTA.

### GENUS MICROCYCLUS, M. and W.

(μικρος, small; κυκλος, a circle; in allusion to its small size and circular form.)

CORALLUM free, or with a minute central point of attachment, discoidal, without columella; calice very shallow, or nearly obsolete, and provided with a single small fossette; septa short, nearly regularly radiating, or with a few of those nearest the fossette converging a little towards its sides; epitheca well developed.

This little coral seems to be related to *Combophyllum* and *Baryphyllum*, Edwards and Haime, but differs from the first in having a well developed epitheca, and from the latter, not only in that character, but in having its fossette simple, and its costæ nearly regularly radiating. It also presents similar differences from *Hadrophyllum*, of Edwards and Haime. As we have sought in vain amongst the established groups for a genus that will receive it, we have been compelled to propose a new genus for its reception.

### MICROCYCLUS DISCUS, M. and W.

Pl. 11, fig 7 *a*, *b*.

CORALLUM depressed-discoid; periphery sharp, under side flat and protected by the concentrically wrinkled epitheca; upper side slightly convex, flat or a little concave in the middle; fossette small, shallow and extending from the center to the margin. Septa very short, thick, extending only about half way in from the margin towards the middle (the central region being smooth), numbering from twenty to twenty-five at their inner ends, but each bifurcating so as to double this number at the margin; sometimes the one on the side opposite the fossette is divided into three.

Breadth of one of the largest individuals, 0.77 inch; height, 0.15 inch.

*Locality and position:* "Devil's Back-bone," Jackson county, Illinois; from the Hamilton group of the Devonian.

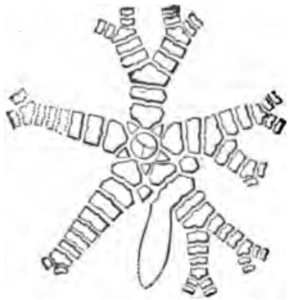
# ECHINODERMATA.

## GENUS TAXOCRINUS, Phillips, 1843.*

### TAXOCRINUS GRACILIS, M. and W.

Pl. 13, fig. 3.

*Taxocrinus gracilis*, MEEK and WORTHEN, Aug., 1865. Proceed. Acad. Nat. Sci., Philad., p. 142.



*Taxocrinus gracilis.*
Diagram showing the structure out to second bifurcation of rays.

BODY small, expanding moderately from the base. Basal pieces very small, and looking like the last joint of the column divided into three pieces; subradial pieces so small and narrow as to allow the lower middle extremity of the first radials to come nearly, or, in some instances, quite down upon the basal pieces; four of them triangular and more or less wedge-shaped so as to project up between the first radials as much as half the length of the latter; the fifth one larger than the others, and apparently minutely truncated above by the anal piece, so as to present a quadrangular or subpentagonal outline. First radial pieces considerably larger than the subradials, of nearly equal length and breadth, or a little wider than long, hexagonal in form, the inferior sloping and upper horizontal sides much longer than the others. Second radials, in four of the rays, shorter than the first, wider than long, and generally hexagonal; in the fifth ray of the specimen under investigation, the second piece seems to have its right margin enormously and perhaps abnornally developed, and extended obliquely upwards, so as to fill the whole interradial space above the comparatively minute interradial piece, quite up as far as the second bifurcation of the rays, with one solid plate. In the ray containing this singularly developed second piece, there are two other primary radial pieces succeeding it, of near the natural size and form, upon the last (fourth) one of which the first bifurcation takes place; after this each of the divisions bifurcate again on the fourth piece, while the two outer ones send off subdivisions, one on the sixth and one on the seventh piece. In the ray immediately to the right of that just described, no division takes place until upon the eighth piece, all the pieces between the second and eighth being transversely oblong or about twice as wide as long, and gradually diminishing in size. In two of the other rays, the first division takes place on the third piece, and the second and third divisions also on the third piece, the arms rather rapidly diminishing in size with each bifurcation. In the fifth ray there appears to be no bifurcation for some distance out, though its exact structure cannot be made out from the specimen examined.

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* For a description and synonymy of this genus, with remarks on its affinities, etc., see vol. ii, p. 268, of the Reports Illinois Geological Survey.

Interradial pieces very small, rather longer than wide, somewhat wedge-shaped above, and resting between the short superior lateral sloping sides of the first radials, and supporting on each superior sloping side a short truncated margin of the contiguous second radials, which generally meet over the little interradial, so as to isolate it from the free space above, though not always. Anal piece a little larger than the interradials, hexagonal in form, and apparently resting with one short side upon a minutely truncated upper side of the largest subradial; while it connects on the right with a first and second primary radial, and on the left with a second and third primary radial, and one first secondary radial.

Surface of body apparently smooth, but showing granules on some of the divisions of the arms. Patelliform accessory pieces not developed between the primary radial pieces, but quite distinct between some of the secondary. Column, as in other species of the group, round and tapering downwards from the base, near which it is composed of very thin pieces.

This species, although somewhat like *T. interscapularis*, Hall (Iowa Report, pl. 1, fig. 3), from the same locality, will be at once distinguished by its more spreading rays, greater interradial and interbrachial spaces, and particularly by its proportionally smaller and shorter interradial pieces, as well as by having the latter resting upon the superior lateral truncated sides of the first radials, instead of upon one of the second, while it has no interaxilary pieces, as seen in *T. interscapularis.* It likewise shows some differences in the bifurcations of its arms, after the first division.

A marked feature in the specimen from which the description was made out, is the extraordinary development of the right margin of one of the second primary radial pieces, by which it is made to fill the entire adjacent interradial space. This, however, as already stated, is probably abnormal.

*Locality and position:* Same as last.

# MOLLUSCA.

## BRACHIOPODA.

### GENUS ORTHIS, Dalman, 1827.

(Uppstalln., p. 110.)

### ORTHIS MCFARLANEI, Meek.

Pl. 13, fig. 10 *a*, *b*, *c*, *d*.

*Orthis McFarlanei*, MEEK, 1868. Transactions Chicago Academy of Science, vol. I, p. 88, pl. xii, fig. 1.

SHELL subcordate, resupinate, very gibbous; length (in adult examples) greater than the breadth; cardinal and umbonal regions very narrow; posterior lateral margins straight, and rapidly diverging forward to the widest part of the valves, which is a little in advance of the middle; hinge line short, or scarcely equaling half the greatest breadth of the valves; cardinal area moderate, nearly twice as high in the ventral valve as in the other, strongly arched in the dorsal valve, and slightly in the ventral, where it is less than half as high as wide, and ranges nearly at right-angles to the plane of the valves; foramen about two-thirds as wide as high. Smaller or ventral valve convex in the lateral and umbonal regions, the most gibbous part being near the beak, which is short and a little incurved at the point; provided with a broad rounded mesial sinus, which commences very shallow near the middle of the valve and widens and deepens rather rapidly towards the front margin, to which it imparts a broadly sinuous outline. Larger or dorsal valve very gibbous, particularly in the region of the umbo, which, in adult shells, projects considerably beyond that of the other, and is at all ages strongly incurved. Surface marked by fine radiating and bifurcating striæ, about nine or ten of which may be counted in the space of 0.10 inch.

Length, 1.05 inches; breadth, 1 inch; convexity, 0.83 inch.

This fine species will be readily recognized by its general form, being nearly always longer than wide, with a very short hinge and an unusually gibbous, narrow, strongly incurved dorsal umbo, which even projects beyond that of the other valve. These peculiarities of form give the shell much the general appearance of some species of *Pentamerus*.

Under a microscope, worn and partly exfoliated surfaces show very distinctly the minute punctures; also occasional larger openings in the striæ, so often seen in the shells of this genus.

*Locality and position:* Independence, Iowa; Hamilton Group of the Devonian system. It also ranges far northward, being originally described from a locality on Mackenzie river, lat. 67 degrees, 15 min., N. British America.

### ORTHIS IOWENSIS, var. FURNARIUS, Hall.

Pl. 13, fig. 9 *a*, *b*.

*Orthis Iowensis*, HALL, 1858. Geological Report of Iowa, vol. I, part II, p. 488, pl. ii, fig. 4 and 5; BILLINGS (1859), HINDS' Report Exploration Assiniboine, Sarkatchewan, etc., p. 193; MEEK (1868), Transac. Chicago Acad. Sci., vol. I, p. 90, pl. xii, fig. 2 *a–h*.

SHELL attaining a rather large size, robust, resupinate, suborbicular in adult examples, a little wider than long, and sometimes more or less emarginate in front, rather compressed in young specimens, but becoming more gibbous with age; hinge very short. Ventral valve much less convex than the other, its greatest convexity being at the umbo, while its anterior margin in mature specimens is often more or less sinuous, or impressed in the middle; cardinal area very small, but well defined and arched; foramen generally a little higher than wide; beak small, arched, and projecting a little beyond the hinge line, being less prominent than that of the other valve. Dorsal valve rather gibbous and regularly arched; beak prominent, strongly incurved; cardinal area rather narrow and distinctly arched; anterior margin in large specimens more or less raised in the middle, for the reception of the depressed margin of the other valve. Surface ornamented with fine, regular radiating striæ, which bifurcate and increase by intercalation, so as to preserve a nearly uniform size and arrangement on all parts of the shell, those on each side of the beaks curving gracefully outwards to the posterior lateral margins, while distinct subimbricating marks of growth traverse the valves concentrically at intervals.

Breadth, 1.40 inches; length, 1.20 inches; convexity, 0.60 inch.

This species will be at once distinguished from the last, by its broader, more rounded, and less convex form, as well as by its less prominent dorsal umbo. None of the Illinois or Iowa specimens we have seen, are of quite so large a size as the species is known to attain at distant northern localities, nor so sinuous or emarginate in front; though they agree exactly with the medium sized and smaller individuals from the latter localities. It seems to be closely allied to *O. striatula*, d'Orbigny, as figured by Schnur, in Dunker and von Meyer's Palæontographica, vol. III, tab. xxxviii, fig. 1 *a–i*.

*Locality and position:* Rock-Island, Illinois, and New-Buffalo and Independence, Iowa; in calcareous shales of the age of the Hamilton group of the New York Devonian. Also in the same position, on Athebasca river, British America.

## GENUS STROPHOMENA, Raf., 1820.

(*Strophomenes*, RAF.; *Strophomena*, BLAINV. (1825), Malac., p. 513.)

### STROPHOMENA RHOMBOIDALIS, Wahlenb. (sp.)

Pl. 10, fig. 7 *a*, *b*.

*Anomites rhomboidalis*, WAHLENB., 1821. Acta. Soc. Ups., vol. III, p. 65.
*Productus depressus*, SOWERBY, 1823. Min. Conch., pl. ccccllix, fig. 3.
*Producta rugosa*, HEISINGER, 1826. Vetensk. Akad. Handl., p. 333.
*Leptæna rugosa*, DALMAN, 1827. Kongl. Vetensk. Handl., p. 106, pl. i, fig. 1.
*Productus quadrangularis*, STEININGER, 1831. Bemerk. uber die Vestein. des Eifels, p. 35.
*Strophomena pileopsis*, DUMONT, 1832. Const. Geol. de la Prov. de Liege, p. 354.
*Productus elegans*, STEININGER, 1834. Mem. Soc. Geol. de France, vol. I, p. 361.
*Strophomena rugosa*, BRONN, 1835. Lethæa Geog. 1, p. 87, pl. ii, fig. 8.
*Producta analoga*, PHILLIPS, 1836. Geol. Yorks , vol. II, p. 215, pl. vii, fig. 10.
*Orthis rugosa*, v. BUCH, 1837. Ueber Delth., p. 70.
*Leptæna tenuistriata*, SOWERBY, 1838. Sil. Syst.. tab. xxii, fig. 2*a*.
*Leptæna distorta*, J. SOWERBY, 1840. Min. Conch., vol. VII, pl. dcxv, fig. 3.
*Leptæna nodulosa*, PHILLIPS, 1841. Palæozoic Foss. Cornw., pl. xxiv, fig. 94.
*Leptæna depressa*, DE KON., 1843. An. Foss. Belg., p. 215, pl. xii, fig. 3; and others.
*Leptagonia rugosa*, McCOY, 1844. Synop. Carb. Foss. Ireland, p. 118.
*Leptagonia multirugata*, McCOY, 1844. Ib. pl. xviii, fig. 12.
*Strophomena rhomboidalis*, var. *analoga*, DAVIDSON, 1860. Carb. Syst Scotland, Geologist, vol. III, p. 102; Monogr. Brit. Carb. Brach., p. 119, pl. xxviii, fig. 1 and 2; Brit. Devonian Brach. (1865), p. 76, pl. xv, fig. 15–17.

THIS species has been so often described, and is so well known, as not to require any extended description here. It is only necessary to state that our specimens seem to agree well with the Devonian shell so generally referred to the species *rhomboidalis*.

In regard to the identity of the different forms for which the various names mentioned in the foregoing synonymy were proposed, different opinions are entertained amongst Geologists and Palæontologists. On this point, however, we are not prepared at present to express a decided opinion, and have consequently merely taken the foregoing synonymy from Mr. Davidson's Monographs, without pretending to have investigated in detail, the claims of the various proposed species therein included. That most of them are synonyms, we do not entertain much doubt; yet it seems very improbable that the same species could have survived all the great changes of physical conditions that must have taken place from the Lower Silurian to the Carboniferous epochs inclusive. It appears to us more probable that there are several distinct species generally confounded under this one name, that are perhaps inseparable by any characters observable in the shell alone, but which presented well marked differences in the structure of the animal. Conchologists are well aware of instances amongst recent Mollusca, where species clearly separable upon well marked differences of the softer parts of the animal, have shells so nearly alike, that if only known to us in the fossilized condition of our Palæozoic species, would scarcely be suspected to be distinct.

*Locality and position:* "Bake-oven," on the Missouri, in Jackson county. Hamilton Group of the Devonian series.

## GENUS TROPIDOLEPTUS, Hall, 1857.*

(Regents' Report for 1856, p. 151.)

### TROPIDOLEPTUS CARINATUS, Conrad, (sp.)

Pl. 13, fig. 2 *a*, *b*, *c*.

*Strophomena carinata*, CONRAD, 1839. Ann. Geol. Report N. Y., p. 64; (not *S. carinata*, CON., 1842).

*Leptæna laticosta*, DE VERNEUIL., 1847. Bull. Soc. Geol. Fr., 2d ser., tome IV, p. 705; SCHNUR (1853), Palæontographica, vol. III, p. 220, pl. xl, fig. 2.

*Strophomena laticosta*, SANDBERGER, 1855. Die Brachiop. des Rheinischen Schicht. Syst. Nassau, p. 66, pl. xxxiv, fig. 8.

*Tropidoleptus carinatus*, HALL, 1857. Report Regents University N. Y., for 1856, p. 151 and 152, fig. 1 and 2; Regents' Report for 1859, p. 31, fig. 1, 2, 3 and 4.

SHELL varying from transversely suboval, to longitudinally semielliptic, plano-convex; hinge generally a little less than the greatest breadth of the valves, somewhat rounded or more or less angular at the extremities; anterior lateral margins rounding to the front, which is regularly rounded, or rarely faintly subangular in the middle. Dorsal valve a little concave, generally provided with a shallow mesial sinus; beak very small and projecting slightly beyond the hinge margin, straight or curved very slightly outwards; cardinal process somewhat prominent. Ventral valve moderately convex, rather flattened towards the posterior lateral extremities, greatest convexity a little behind the middle; beak small, slightly arched, and projecting very little beyond the cardinal margin; area generally narrow, with nearly parallel sides, and extending to the extremities of the hinge, ranging nearly parallel to the plane of the valves; foramen broad, subtrigonal, the upper angle being rounded at the beak, nearly closed by the cardinal process. Surface ornamented by about eighteen to twenty regular, simple, depressed and rounded plications on each valve, the middle one of which, on the ventral valve, is somewhat larger than the others, so as sometimes to produce a faintly subcardinate appearance; while a corresponding slightly larger furrow occupies the mesial line of the opposite valve; lines of growth fine, rather distinct, and with the regularly and coarsely punctate structure of the shell, giving the surface a beautiful ornate appearance, as seen under a common pocket lens.

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* Prof. Hall *named* this genus in 1857, but did not *describe* it, so far as we have been able to learn, until 1859 (Regents' Report, p. 31).

Length of one of the larger western specimens, 0.90 inch; breadth, 1 inch; convexity, 0.20 inch.

This shell varied considerably in form at different stages of its growth, and in different individuals. As may be seen by the marks of growth, young specimens are sometimes transversely semicircular, with rather acutely angular lateral extremities. As the shell increased in size, it grew more rapidly in length than in breadth, and the lateral extremities became more obtusely angular, or even a little rounded. These variations of form at different ages, are as clearly indicated by the marks of growth on some New York specimens before us as in the western examples. The particular individual we have figured, has the lateral extremities nearly rectangular, but in others from the same locality they are more rounded, as in those from New York. We know of no other shell with which this is liable to be confounded.

*Locality and position:* Same as last.

## GENUS PENTAMERUS, Sowerby, 1813.

(Min. Conch., tab. 28.)

### PENTAMERUS COMIS, Owen? (sp.)

Pl. 13, fig. 6 *a*, *b*, *c*.

*Atrypa comis*, OWEN, 1855. Report Geol. Survey Wisconsin, Iowa and Minnesota, p. 583, pl. iii A, fig. 4.

*Pentamerus occidentalis*, HALL, 1858. Iowa Report, vol. I, part II, p. 514, pl. vi, fig. 2 *a*, *b*, *c*; (not *P. occidentalis*, HALL, 1852, Palæont. N. Y., vol. II, p. 341, pl. lxxxix, fig. 1 *a–e*, and 2.)

*Pentamerus galeatiformis*, MEEK and WORTHEN, 1866. Report Geol. Survey Illinois, vol. II, p. 325; where it is by typ. err. *geleatiform.*

SHELL globose-subovate, very gibbous, generally about as wide as long. Dorsal valve moderately convex; beak incurved; front slightly depressed in the middle, so as to form a very shallow sinus, and sometimes provided with a few short, obscure, rounded irregular plications; lamellæ of interior nearly parallel, and not quite extending to the middle. Ventral valve very convex, particularly in the region of the umbo, which is prominent, and strongly incurved over and upon that of the other valve; front sometimes slightly raised in the middle and faintly subplicated, so as to form at the immediate margin an obscure mesial prominence, and a few folds corresponding to the irregularities of the margin of the other valve; internal chamber and mesial septum rather short. Surface smooth.

Length and breadth, 0.88 inch; convexity, 0.70 inch.

This species has much the general appearance of some of the smoother varieties of *P. galeatus*; but so far as yet known it never has its plications near so strongly developed, nor continued so far back from the front margin, as we usually see in that species; while casts show that the internal chamber and septum of its ventral valve, as well as the septa of its dorsal valve, are shorter.

Although Dr. Owen's figure and description of his *Atrypa comis* are not very satisfactory, we have now little doubt but it was the above described species that he named. It is true, he mentions no plications, but they are often so very obscure on this shell that they might be readily overlooked; while some very faint indications of plications seem to be seen on the left side of his figure.

We know little of the internal characters of this shell from any specimens we have had an opportunity to see, but Prof. Hall expresses the opinion in the Twentieth Ann. Rep. Regents Univ., N. Y., on the State Cab. Nat. Hist., p. 163, that it presents differences of generic importance from *Pentamerus*, and he proposes for the type the name *Gypidula.* If this separation should be sustained, the name of the species will become *Gypidula comis*, if we are right in identifying the species with Owen's figure.

*Locality and position:* Rock-Island, Illinois; Hamilton Group of the Devonian series.

## PENTAMERUS SUBGLOBOSUS, M. and W.

Pl. 13, fig. 5 *a*, *b*, *c*.

SHELL small, subglobose, about as wide as long. Dorsal valve wider than long, evenly and rather distinctly convex, regularly arched from beak to front; beak short and incurved. Ventral valve strongly arched, more convex than the other, the greatest convexity being a little behind the middle; beak short and distinctly incurved, so as to come in contact with that of the other valve, but not distinctly overlapping it. Surface of each valve ornamented with about nine or ten small, angular plications, four or five of which are a little larger and very slightly more prominent than the others, on the middle of the ventral valve, and a few of those at the immediate front of the dorsal valve slightly more depressed; plications scarcely extending back beyond the middle, and crossed by very fine undulating lines of growth.

Length, 0.52 inch; breadth, 0.54 inch; convexity, 0.43 inch.

This little shell will be distinguished from the last by its more numerous, more angular, and more strongly defined plications, as well as by its shorter and less attenuated ventral beak. Its dorsal valve is also proportionally more convex, and more regularly arched. So far as yet known, it is also a considerably smaller shell; while young individuals of the last described species, of corresponding size, or even one-third larger, are entirely without any traces of plications.

*Locality and position:* Rock-Island, Illinois; Hamilton Group of the Devonian series.

## GENUS ATRYPA, Dalman, 1827.

(Vet. Akad. Handl., xx.)

### ATRYPA ASPERA, Schlotheim (sp.)

Pl. 13, fig. 7 *a*, *b*, *c*, *d*.

*Terebratulites aspera*, SCHLOTHEIM, 1813. Min. Taschenb., vol. VII, pl. 1, fig. 7; Petrefact., p. 263.

*Atrypa aspera*, DALMAN, 1827. Vet. Akad. Handl., pl. 4, fig. 8; HEISINGER (1837), Leth. Suec., pl. 21, fig. 12; PHILLIPS (1841), Palæozoic Foss., pl. xxxiii, fig. 144; DAVIDSON (1865), Monogr. Brit. Devonian Brach., pl. x, fig. 5–8; MEEK (1868), Trans. Chicago Acad. Sci., vol. I, p. 96, pl. xiii, fig. 12; and of others.

*Atrypa spinosa*, HALL, 1843. Geol. Report Fourth Dist. N. Y., p. 200.

*Terebratula aspera*, MURCH., VERN. and KEYS., 1845. Geol. Russ., vol. II, p. 93, pl. x, fig. 13.

*Atrypa aspera*, var. *occidentalis*, HALL, 1858. Iowa Report, vol. I, part II, p. 515, pl. vi, fig. 3 *a*, *b*, *c*, *d*.

SHELL longitudinally suboval, varying to subcircular, rarely a little wider than long; very gibbous and inequivalve in adult specimens. Ventral valve but slightly convex in the umbonal region, and distinctly sinuous, though not emarginate, in front; beak very small, a little prominent, and closely incurved upon that of the other valve; foramen minute. Dorsal valve much more convex than the other, and becoming very gibbous in adult specimens, regularly and strongly arched from beak to front; beak incurved. Surface of both valves ornamented with large, rounded, bifurcating plications, crossed at intervals by regular, distinctly elevated and vaulted concentric lamellæ, which are sometimes produced in the form of hollow spines.

Length of a large individual, 1.33 inches; breadth, 1.26 inches; convexity, 0.93 inch.

Specimens of this shell from Iowa and western Illinois generally have the plications much larger and less numerous than those found in the Hamilton group, of New York; and in this respect agree more nearly with some of the European examples. These more coarsely plicated western examples Prof. Hall proposed to designate as *A. aspera*, var. *occidentalis*. Even at the western localities, however, these shells vary considerably in this and other characters, as may be seen by the two individuals we have figured. Some authors regard all these shells as merely varieties of *A. reticularis*, Linn. (sp.), which is generally merely ornamented with more or less fine, radiating striæ, with projecting laminæ of growth. Although the varieties of these two types are sometimes very difficult to separate, it seems probable that the softer parts of the animal of each were nevertheless characterized by specific differences.

*Locality and position:* Rock-Island, Illinois, and New-Buffalo and Independence, Iowa; in Calcareous shales belonging to the horizon of the Hamilton Group of the New York Devonian series. This species is also very common in the same position in New York, and various other localities of the United States. Mr. Kennicott likewise brought specimens of it from the Devonian rocks of a distint locality, on Mackenzie river, British America, as high north as the seventy-sixth degree of latitude, and had others presented to him from near the same latitude in Russian America. It is also widely distributed in Europe.

## ATRYPA RETICULARIS, Linnæus, (sp.).

Pl. 13, fig. 11.

*Anomia reticularis*, LINN., 1767. Syst. Nat., vol. 1, 12th ed., p. 1152.

*Terebratulites priscus*, SCHLOTHEIM, 1820. Petrefact., vol. I, p. 262; II, p. 68, 69, t. xvii, fig. 2; t. xx, fig. 4.

*Anomites reticularis*, WAHLENB., 1821. Act. Soc. Upsalensis, VIII, p. 65.

*Terebratula affinis*, SOWERBY, 1823. Minn. Conch., vol. IV, p. 24, pl. cccxxiv, fig. 2.

*Atrypa reticularis*, DALMAN, 1827. Vet. Akad. Handl., pl. iv, fig. 2.*

THIS common and almost universally distributed species is so fully described in various works on geology and palæontology, as to render a formal detailed description of it here scarcely necessary. For the information, however, of students who may not have access to other works, it is proper to state that it is an exceedingly variable shell, both as to size and form. Its most usual form, however, is longitudinally suboval, or approaching obovate, the widest part being generally behind the middle, with cardinal margins more or less sloping from the beaks to rounded lateral borders, and the anterior margin somewhat narrowly rounded, or, in some examples, a little truncated. The dorsal valve is more convex than the other, with a strongly incurved beak. The ventral valve is compressed-convex in the umbonal region, more or less flattened or concave on each side, and impressed, or sometimes rather distinctly sinuous at the front; its beak is small, projecting little beyond that of the other valve, and closely curved over and upon it. The surface is ornamented with more or less fine, or coarse radiating striæ or ribs, with, at intervals, concentric marks of growth, from which, in well preserved specimens, project free laminæ, sometimes extending as much as an inch or more beyond the margins of the valves. As generally found, however, particularly as broken from a hard rock, these laminæ are removed from the surface, and the shell presents a very different appearance from that of a perfect example. The individual we have figured on plate 13 came from a shaly matrix, and retains portions of the projecting laminæ extending far out beyond the true margins of the valves, showing that it must have presented a transversely suboval, or nearly semicircular form, as indicated by the restored outline. The form of the valves, if the free laminæ were removed, would be nearly as indicated by the inner broken line.

Some varieties of this shell are considerably wider than long, and in these dilated forms the hinge line is straight, and often terminates in nearly or quite rectangular extremities. The radiating striæ are subject to great variations in size, which, together with other differences, have caused various specific names to be proposed upon these variations. Most palæontologists, however, regard all these as merely varieties of one extremely variable species, modified by local and other causes; while others think the series includes at least four or five closely allied but distinct species. The fact that several of these real or supposed varieties are mainly or entirely confined to particular horizons, seems to favor the latter conclusion. In this country, the large dilated variety, with a nearly or quite straight hinge, seems to be characteristic of the Hamilton group, or of beds belonging to near that division of the Devonian; while in the Silurian, the shell is generally much smaller, with the hinge margins usually more sloping from the beaks.

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* For the long list of other names that have been applied to this species, or to forms supposed to be only varieties of it, see Mr. Davidson's Monographs of the British Silurian and Devonian Brachiopoda.

Length of a very large individual, exclusive of the extended laminæ, 1.90 inches; breadth, 2 inches; convexity, about 1 inch.

*Locality and position*: Rock-Island, Illinois, and New-Buffalo, and Independence, Iowa, in shaly beds of the age of the Hamilton group of the Devonian. It is also common at the same horizon, as well as in the Upper Silurian rocks of New York, and at numerous other localities in other American States. It likewise has a wider range in the Devonian beds of British America, and in the upper Silurian and Devonian rocks of Europe. In short, it seems to be, in some of its real or supposed varieties, almost universally distributed wherever fossiliferous Upper Silurian or Devonian rocks exist.

## GENUS SPIRIFER, Sowerby, 1815.

(Min. Conch. II, p. 42.)

### SUBGENUS, TRIGONOTRETA, Kœnig, 1825.

(Icon, sect. part I.)

### SPIRIFER FORNACULA, Hall.

Pl. 13, fig. 8 *a*, *b*, *c*.

*Spirifer fornacula*, HALL, 1857. Report Regents University of N. Y. for 1856, p. 154.

SHELL attaining a medium size, thin, semicircular; hinge line equaling the greatest breadth, which is less than twice the length. Dorsal valve moderately convex; mesial fold narrow, smooth, rather depressed and rounded, or more or less flattened on top, with sometimes a faint furrow along the middle; beak projecting a little beyond the hinge, and distinctly incurved. Ventral valve distinctly more convex than the other, most prominent at the beak, thence sloping, with a moderate convexity, to the lateral and anterior margins; beak prominent, distant from the other, and but very slightly curved; area high, triangular, ranging nearly at right angles to the plane of the valves, strongly defined by rectangular margins, nearly flat or very slightly arched, and finely but obscurely striated vertically and longitudinally; foramen rather narrow, being higher than wide; mesial furrow narrow, rather shallow, smooth and rounded, or somewhat flattened within. Surface ornamented with from about fifteen to twenty-four simple rounded plications on each side of the mesial fold and sinus, and marked by fine concentric striæ of growth.

Length, 1.04 inches; breadth, 1.75 inches; convexity, 0.90 inch.

This shell seems to be *very* closely allied to several forms described by Prof. Hall under other names, but not yet figured. Until these have all been fully illustrated, it is impossible to make detailed comparison without specimens of all these forms. On comparison with specimens believed to be the form he has described under the name *S. segmentus*,* they are found to be very similar, though the form under consideration has its area slightly more arched, its foramen a little narrower, and the mesial fold rather more depressed; while its marks of growth are less strongly defined. The specimen figured by us, however, and the few others we have had an opportunity to examine, have the shell mainly exfoliated so as to give them an unnaturally smooth appearance.

*Locality and position:* "Bake Oven," Jackson county, Illinois, from beds of the age of the New York Hamilton group, of the Devonian.

## SPIRIFER SUBUNDIFERUS, M. and W.

Pl. 10, fig. 5 *a*, *b*, *c*, *d*, *e*.

SHELL attaining a moderately large size, somewhat wider than long, transversely oval, rather convex; lateral margins compressed at the extremities of the hinge, and rounded in outline; front irregularly rounded, being most prominent in the middle at the termination of the mesial fold and sinus; hinge shorter than the breadth of the valve. Ventral valve a little more convex than the other; beak moderately prominent, and rather distinctly arched; area of moderate breadth near the beak, but becoming rapidly narrowed farther out, and scarcely extending to the ends of the hinge, strongly arched with the beak, and provided with a rather wide triangular foramen; mesial sinus somewhat flattened or rounded within, shallow or of medium depth and breadth, narrowing regularly from the front, but continued quite to the beak, and having on each side five well defined, stout, simple, broadly rounded plications (with faint indications of a sixth near each hinge extremity), separated by rounded furrows. Dorsal valve most convex anteriorly; mesial fold prominent, with abruptly sloping sides, and usually a shallow depression or furrow along its middle; lateral slopes convex, and each provided with four well defined, and one obscure, broadly rounded, simple plications; beak projecting beyond the hinge line, and distinctly incurved.

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* *S. segmentus* Hall, seems to us to agree almost exactly, in every respect, with *S. subcuspidatus*, Schnur (Palæontographica, vol. III, p. 202, tab. xxxiii, fig. 3 *a-f*, 1854); not *S. subcuspidatus*, Hall, Iowa Report, 1858.

Breadth of largest specimen, 2.10 inches; length, 1.90 inches; convexity, 1.24 inches.

All the specimens of this shell we have seen are mainly casts, exhibiting little beyond the size, general form, and large plications. One of them, however, retains some portions of the shell, and at one place, about midway between the beak and lateral margin, a small piece showing the surface markings. On this may be seen, by the aid of a magnifier, delicate, minutely crenated, or pitted, concentric striæ, very regularly arranged, so that six of them may be counted in one-tenth of an inch, and apparently all undulated in crossing the round plications and intervening furrows.

Unfortunately our figures of this species are not engraved in a very satisfactory manner, too much of the shading being done by the general ruling. In attempting to lengthen up the plications by the means of a burnisher, they are also at places made to appear too angular; while the mesial fold on figure 5 *a* and 5 *d* is not prominent enough, and the sulcus along the middle of that of 5 *d* is too broad. The apparent bifurcation of one of the plications on the right side of figure 5 *a* is also an error, the plications being always simple and rounded.

This species is probably most nearly allied to *S. undiferus*, of Rœmer, but differs in having a smaller number of, as well as larger and more prominent, plications. Its area is also less defined, and narrows more rapidly outwards from the beak on each side.

*Locality and position:* Rock-Island, Illinois; in the Hamilton division of the Devonian series.

## GENUS CYRTINA, Davidson, 1858.

(Monogr. Brit. Carb. Brach., p. 66.)

### CYRTINA TRIQUETRA, Hall (sp.)

Pl. 13, fig. 4 *a*, *b*, *c*, *d*.

*Cyrtia triquetra*, HALL, 1858. Iowa Report, vol. I, part II, p. 513.
*Cyrtina triquetra*, MEEK, 1868. Transactions Chicago Acad. Sci., vol. I, p. 99.

SHELL small, subpyramidal, wider than long; hinge line equaling the greatest breadth, and terminating in nearly rectangular lateral extremities; anterior outline more or less regularly rounded, with sometimes a faint mesial emargination. Dorsal valve semicircular, depressed-convex; mesial fold moderate, rounded and well defined; beak scarcely extending beyond the hinge line, and slightly arched. Ventral valve greatly elevated, the highest point being the beak, which is straight or very slightly arched; mesial sinus corresponding in size to the sinus of the other valve; area high, triangular, nearly flat, and standing at right-angles to the plane of the dorsal valve; foramen very narrow, closed by the pseudo-deltidium below, and open above. Surface ornamented by seven to eight or nine simple plications on each side of the mesial fold, and about nine to ten on each side of the mesial sinus, the two bounding the sinus being larger and more prominent than any of the others; marks of growth fine, and on well preserved specimens subimbricating; punctate structure visible by the aid of a pocket lens.

Length, 0.26 inch; breadth, 0.45 inch; convexity, 0.30 inch.

This species is chiefly distinguished from *C. acutirostris*, of Shumard (Missouri Report, p. 204, pl. C, fig. 3 *a*, *b*, *c*), by its smaller and more numerous plications. It is very similar to some of the forms referred to *C. heteroclyta*, by European authors.

*Locality and position:* Same as last.

## GENUS LINGULA, Bruguiere, 1792.

(Eucyc. Meth. 1, tab. 250.)

### LINGULA SUBSPATULATA, M. and W.

Pl. 13, fig. 1.

WE only know this shell from almost perfectly flattened specimens, apparently of the ventral valve. They have an elliptic outline, with length and breadth as five to three. Its lateral margins form very nearly elliptic curves from the beak to the front, which is rather more narrowly rounded than represented in our figure. The slopes of the cardinal margin are scarcely straight, even near the beak, which is only rather obtusely angular. Surface marked by fine concentric lines, and traces of more minute, less distinct radiating striæ.

The appearance of a depression, or of distinct, continuous radiating lines, along the middle, from the beak to the front, in our figure, is an error in the engraving. On internal casts some faint traces of radiating marks are seen near the beak, and sometimes forward to or beyond the middle, but not forming a distinctly defined band; nor is there any furrow on the internal cast.

Length, 0.53 inch; breadth, 0.32 inch.

This species has been sometimes referred to *L. spatulata*, of Hall, from the Genesee Slate, of the New York Devonian series; but in addition to being much larger, it is distinctly broader in proportion to its length, and has a more angular beak. It is still less like *L. concentrica*, from the New York Genesee Slate.

*Locality and position:* Near Jonesboro, Union county, Illinois; from the "Black Slate," at the top of the Hamilton division of the Devonian series.

# LAMELLIBRANCHIATA.

## GENUS PTERINEA, Goldf., 1832.

(Naturh Atl., tab. 312.)

### PTERINEA? SUBPAPYRACEA, M. and W.

Pl. 11, fig. 5.

*Pterinea? subpapyracea*, MEEK and WORTHEN, 1866. Proceed. Chicago Acad. Sci., vol. I, p. 21.

SHELL (left valve) under medium size, obliquely suboval, moderately convex, very thin; anterior and basal margins forming a semicircular curve to the posterior extremity, which is narrowly rounded and somewhat produced near the middle, above which the posterior margin is nearly straight and ascends obliquely forward to the posterior wing. Beak rather obtuse, and placed considerably in advance of the middle of the shell. Hinge short, ranging at an angle of about twenty-eight degrees above the obliquely sloping posterior margin. Posterior wing small, compressed, considerably shorter than the posterior extremity of the valve, pointed at the extremity, and slightly sinuous behind; anterior wing shorter than the other, compressed, and apparently nearly rectangular. Surface ornamented with alternately larger and smaller thread-like, obscurely subcrenate radiating striæ, separated by wider flattened spaces; the whole being crossed by concentric lines, sometimes producing a sub-cancellated style of marking.

Length, measuring obliquely from the anterior wing to the narrowly rounded posterior extremity, 0.74 inch; height, or diameter at right angles to the hinge, 0.60 inch; length of hinge-line, 0.42 inch.

This shell resembles very closely the cretaceous species *Avicula Nebrascensis* of Shumard, from the Upper Missouri. Its widely different geological position, however, is alone a strong presumptive evidence that it must be specifically distinct. As we know nothing of its hinge or interior, we can only refer it provisionally to the genus *Pterinea*. If not a true *Pterinea*, it will doubtless have to be called *Avicula* or *Pteria subpapyracea*, depending upon which of these two names is to be retained for that genus.

The shading on our figure makes the posterior portion look too convex.

*Locality and position:* Falls of the Ohio river; Devonian.

## GENUS MODIOLOPSIS, Hall, 1847.

(Palæont. N. Y., vol. I, p. 157.)

### MODIOLOPSIS? PEROVATA, M. and W.

Pl. 11, fig. 2.

*Modiolopsis perovata*, MEEK and WORTHEN, 1865. Proceed. Acad. Nat. Sci., Philad., p. 246.

SHELL longitudinally ovate, the widest part being a little behind the middle, compressed, very thin, extremely inequilateral and oblique; posterior side compressed, cuneate, regularly rounded in outline; anterior side very short, more narrowly rounded than the posterior margin. Dorsal outline forming a broad, nearly regular arch, from the beaks into the posterior border; base oblique, and somewhat straightened just in front of the middle, and rounding up towards the extremities. Beaks compressed, scarcely projecting beyond the rounded anterior outline, and placed directly over the anterior extremity. Surface marked with regular concentric striæ, and small, irregular furrows. Anterior muscular impression oval, distinct, located close to the margin, under the beak.

Length, 1.92 inches; height, 1.18 inches; convexity, 0.40 inch.

This species has much the general appearance of *Modiola concentrica*, (Hall, Geol. Fourth Dist. p. 196, fig. 9), but differs in having its anterior outline rounded, instead of protuberant and subangular in outline. Its margin is also more prominent in the antero-ventral region, and without "a longitudinal impression directly below the beaks."

Our figure of this shell is too narrowly rounded posteriorly, and too widely round in front. The beak in the anterior margin shows the cast of the muscular impression, and the end of the pallial line connecting with it, but these are not well represented in the figure. As we know nothing of the nature of its hinge, we of course only refer it provisionally to the genus *Modiolopsis.*

*Locality and position:* White Sulphur Springs, Delaware county, Ohio; Hamilton Group of Devonian series.

## GENUS GRAMMYSIA, de Verneuil, 1847.

(Bull. Soc. Geol. Fr., IV, p. 696.)

### GRAMMYSIA? RHOMBOIDALIS, M. and W.

Pl. 11, fig. 5 *a*, *b*.

*Grammysia rhomboidalis*, MEEK and WORTHEN, 1865. Proceed. Acad. Nat. Sci., Philad., p. 248.

SHELL rather large, very gibbous, presenting a rhombic form as seen in a side view, and a distinctly cordate outline as seen in an anterior or posterior view; umbonal slopes extremely prominent and very oblique; beaks nearly terminal, approximate at their points, rising above the hinge line, and distinctly curved inwards and forwards; anterior and antero-ventral regions immediately in front of the oblique umbonal ridge, abruptly contracted, with a broad undefined depression extending from the front part of the beaks obliquely to a point near the middle of the base; dorsal region between the umbonal ridge and the cardinal margin, a little concave near the beaks. Posterior margin obliquely truncated with a moderately convex outline to the posterior basal extremity, which is subangular, or very narrowly rounded; base rather long, a little convex in outline behind the middle, and straight or slightly sinuous just in front of it, but rounding obliquely upward anteriorly. Anterior side (which is imperfect in our specimen) short, or apparently not projecting much beyond the beaks, more or less obliquely rounded, and apparently somewhat gaping; cardinal margin (judging from casts) rather short, and inflected so as to form behind the beaks a distinctly defined, rather wide depression or escutcheon. Surface, as near as can be determined from casts, ornamented with small, regular concentric ridges. Hinge, muscular and pallial impressions, unknown.

Length, about 3.55 inches; height, 2.06 inches; greatest breadth (near the middle of valves), 2.42 inches.

The most marked peculiarities of this shell are the remarkable prominence and obliquity of its umbonal ridges (which near the beaks stand out as if compressed antero-posteriorly), and the nearly terminal, obliquely incurved character of the beaks. The specimen is not in a condition to show whether or not it has a distinct lunule in front of the beaks, but we suspect that it has. In some respects it resembles in form *Cyrtodonta Hindi* of Billings, from the Cincinnati group (=Hudson river beds) of Canada, but differs in having its umbonal ridges so much more prominent as to give greater convexity to the valves; while its umbones, although more prominent, are much narrower in their antero-posterior diameter. More important differences, however, are the presence of a broad undefined sulcus, extending obliquely from the anterior side of the beaks of our shell, to near the middle of its base, and the apparent slightly gaping character of its anterior side. Notwithstanding the general resemblance of these forms, there can be little doubt but they really belong to distinct families, since the Canadian shell doubtless belongs to the *Arcidæ*, while that before us appears to be related to the *Anatinidæ*.

Although we have placed our shell provisionally in the genus *Grammysia*, we strongly suspect that when its hinge and interior can be seen, it will be found to be either generically or subgenerically distinct from *G. bisulcata*, Con. sp., the type upon which that genus was founded. At any rate, it differs materially in form, and the prominence of its umbonal ridges, as well as in the absence of a mesial ridge and furrows, extending from the beaks to the middle of its basal margin, from that and other well determined species of the genus.

Should it be found necessary to establish a new genus for this shell, we have proposed to call it *Rhombocardia*. We remember a somewhat similar, but distinct species, from the New York Hamilton group, which, if we mistake not, has been described by Mr. Conrad.

Owing to the defective shading of the engravings of this shell, our figures look too flat, and fail to convey a correct idea of some of its characters.

*Locality and position:* "Bake Oven," Jackson county, Ill., Hamilton Group.

# GASTEROPODA.

## Genus PLATYCERAS, Conrad, 1840.*

(Ann. Rep. Palæont. N. Y., p. 205.)

### Platyceras ventricosum, Conrad.

Pl. 11, fig. 4 *a*, *b*.

*Platyceras ventricosum*, Conrad, 1840. Ann. Report Palæont. N. Y., p. 206; Hall (1859), Report Regents Univ. of N. Y., p. 17, fig. 1 and 2; Palæont. N. Y., vol. III, p. 311, pl. lvi, fig. 1–4 and 8; and pl. lvii, fig. 4; also p. 475, pl. cxviii, fig. 8–9.

Shell obliquely subovate, composed of two and a-half to three very rapidly enlarging, contiguous volutions, the last one of which is remarkably large and ventricose; spire depressed below the upper side of the body whorl; aperture very large and circular; inner lip generally in contact with the spire so as to leave a moderately large umbilical cavity; surface traversed by fine striæ, and near the aperture, coarser somewhat undulated marks of growth, crossed by faint traces of extremely fine revolving lines.

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* For remarks on this genus see page 384.

Greatest transverse diameter of a large well developed specimen, 1.78 inches; height (which is also the height of the aperture), 1.40 inches; breadth of aperture, 1.25 inches.

Although *P. ventricosum* has not, we believe, been hitherto found above the horizon of the Oriskany sandstone, our specimen of the shell under consideration agrees so exactly in every respect with authentic examples of that species before us from New York, and Cumberland, Maryland, that we are completely at a loss to find any appreciable differences. Indeed it agrees quite as well with typical examples of *P. ventricosum* as they agree with each other. We have the more confidence in its identity with Mr. Conrad's species, because several species of other shells not found in New York above the Oriskany, are known to occur in the Hamilton group in Canada.

The specimen we have figured has the lip somewhat broken away on the upper side, so that figure 4 *a* does not show its outline entire. The lines of growth on that figure are also too oblique, and not undulated enough near the aperture. Figure 4 *b* is a somewhat oblique view, and shows the apex of the spire too distinctly. In looking directly into the aperture, so as to see its full outline, the apex of the spire is not visible.

*Locality and position:* New-Buffalo, Iowa; Hamilton group of the Devonian.

## GENUS ISONEMA, M. and W., 1865.

(ισος, equal; νημα, a thread, in allusion to its equal lines.)

*Holopea*, subgenus *Isonema*, MEEK and WORTHEN, 1866. Proceed. Acad. Nat. Sci., Philad., p. 251.

SHELL depressed sub-globose, turbinate, or conical-subovate, obtusely angular around the middle of the body whorl; aperture sub-rhombic; outer lip thin, entire; inner lip a little flattened or impressed in the umbilical region, apparently for the support of an operculum, very thin, or scarcely continuous above; axis imperforate; surface ornamented with transverse, very regular lines on the upper side of the volutions.

In 1865 we proposed the name *Isonema* for this type, as a subgenus under *Holopea*. Farther comparisons, however, have since led us to regard it as generically distinct from *Holopea*, from which it differs in its angular instead of rounded volutions, as well as in its imperforate axis, flattened inner lip, rhombic instead of rounded aperture, and strong regular lines of growth. From *Pleurotomaria* it will be at once distinguished by its entire lip, and the absence of a revolving band on the whorls. From *Cyclonema* it differs in being entirely without the characteristic revolving lines of that genus, and marked by strong transverse striæ.

In addition to the typical species here described, this genus includes *I. bellatula*=(*Loxonema bellatula*, Hall; 15th Report Regents Univ. N. Y., p. 163, fig. 4 and 5). These shells differ widely from *Loxonema* of Phillips, in their greatly more depressed, broad form, smaller number, and more angular whorls, and straight or slightly arched, instead of inversely sigmoid lines of growth.

## ISONEMA DEPRESSA, M. and W.

Pl. 11, fig. 6 *a*, *b*, and the annexed cuts.

*Holopea* (*Isonema*) *deprsssa*, MEEK and WORTHEN, 1865. Proceed Acad. Nat. Sci., Philad., p. 251.

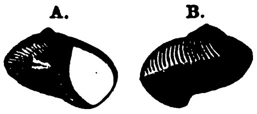

Fig. A, shows the aperture and columella.
Fig. B, back view of the shell showing the regular lines of the surface.

SHELL depressed subturbinate, considerably wider than high; spire very low; volutions nearly four, increasing rather rapidly in size, obliquely compressed, with a slightly convex outward slope above; last turn but little convex below, between the angular periphery and the imperforate umbilical region; suture well defined; aperture as wide as high. Surface with lines of growth strong, very regular, and numbering about four or five in the space of 0.10 inch on the upper side of the body whorl, where they sometimes bifurcate, and arch very slightly forward in passing across from the suture to the periphery, below which they suddenly become nearly obsolete and pass a little obliquely backwards to the umbilical region. Furrow on the flattened lower part of the inner lip, for the support of the operculum, well defined.

Height, 0.38 inch; breadth, 0.56 inch.

This species is allied to *I. bellatula*, Hall (sp.), but differs greatly in its more depressed form, being sometimes nearly twice as wide as high, while that species is represented as distinctly higher than wide, and described as being "moderately elongated." Our shell also has its periphery distinctly more angular. In surface markings and other characters, these shells are very similar.

In our figure 6 *b*, pl. 11, the transverse lines are too indistinct and too fine, but they are correctly represented in the above cut B.

*Locality and position:* Delaware county, Ohio; Devonian, of about the age of the Hamilton Group.

# CEPHALOPODA.

## GENUS GOMPHOCERAS, Sowerby, 1839.

(In Murch. Sil. Syst., p. 621.)

### GOMPHOCERAS TURBINIFORME, M. and W.

Pl. 12, fig 2 *a*, *b*.

*Gomphoceras* (*Apioceras*) *turbiniforme*, MEEK and WORTHEN, 1866. Proceed. Acad. Nat. Sci., Philad., p. 258.

SHELL rather small, turbinate or obovate, very slightly unsymmetrical; section circular, or nearly so; chambered part rapidly expanding, with sides slightly convex above. Non-septate part very short, or three times as wide as long, rounding in abruptly above; aperture contracted, but exact form unknown. Septa only moderately concave, nearly equidistant at all points, excepting near the outer chamber and the apex, where they are more crowded; at about the widest part of the shell, separated by spaces equaling one-eighth its greatest diameter. Siphon small and marginal. Surface nearly smooth, or with only fine lines of growth.

Length of a specimen not quite complete at the smaller extremity, 1.16 inches; greater breadth, at the junction of the septate and non-septate parts, 1 inch; smaller diameter at the same place, 0.90 inch; greater diameter at the smaller extremity, 0.32 inch; smaller do. at same place, 0.30 inch; divergence of sides from smaller end, 30°.

This is a very short turbinate species, somewhat like *G. beta*, Hall, (15th Report Regents, pl. 7, fig. 1), but differs in being proportionally shorter and more ventricose, and in having the septa proportionally more crowded. It shows eleven septa in a space of three-quarters of an inch below the last one, while *G. beta* is described as having only seven or eight in the same space.

Its last three septa are crowded within a space only equaling one of the chambers below.

*Locality and position:* Charleston, Indiana; Devonian.

## GENUS CYRTOCERAS, Goldf., 1832.

(In Dechen's Germ. transl. de la Bache, p. 536.)

### CYRTOCERAS SACCULUM, M. and W.

Pl. 12, fig 3 *a*, *b*, *c*.

*Gomphoceras sacculum*, MEEK and WORTHEN, 1866. Proceed. Acad. Nat. Sci., Philad., p. 258.

**SHELL** small, subfusiform, or clavate, very slightly arched or convex on the ventral side, and nearly straight on the dorsal; a little compressed at right angles to the plane of the curve, particularly the non-septate part, which is more convex on the outer side of the curve than the inner; most ventricose a little above the last septum, thence tapering gradually to the lower extremity and towards the aperture, near which latter there is a slight constriction. Section transversely a little oval near the middle of the shell, and more decidedly so above, but nearly or quite circular towards the lower extremity. Aperture transversely oval, its smaller diameter being about two-thirds the greater; lip faintly sinuous at each end of the aperture and at the middle of the ventral or convex side. Septa but slightly concave; (distance between them not distinctly determinable from the specimen examined). Siphon very small, placed on the line of the shorter axis of the septa, about twice its own breadth from the ventral or outer side of the curve. Surface marked only with small annular striæ, slightly arched backwards near each end of the aperture, parallel to the faint sinuosities of the lip.

Length of specimen, imperfect at the smaller extremity, 1.27 inch; do. of nonseptate part, 0.67 inch; greatest transverse diameter of do., 0.53 inch; shorter diameter of do. at same point, 0.42 inch. Angle of divergence of septate half of the shell, measuring along each lateral margin, 24°. Breadth of aperture, 0.33 inch; smaller diameter of do., 0.22 inch.

This little shell has the general habit and appearance of *Gomphoceras*, and yet differs from the typical forms of that genus in being slightly arched and not having its aperture so remarkably contracted. In being a little curved, it more nearly resembles *Phragmoceras*, though its curvature is less decided. It is also worthy of note, that the comparatively small contraction of its aperture is mainly on the dorsal and ventral margins, while in *Gomphoceras* and *Phragmoceras* the contraction is mainly on each lateral margin. Since referring it to the genus *Gomphoceras*, farther comparisons have led us to regard it as belonging more properly to the genus *Cyrtoceras*, although it seems to be an intermediate type between these genera. If Prof. Hall's proposed genus *Oncoceras* should be retained, it is possible this species might be included in it, as suggested by us in first publishing a description of it. In its peculiar Gomphoceras-like form, it resembles *C. heteroclytum* of Barrande (Syst. Sil. Bohme, vol. II, p. 550, pl. 118, fig. 15–18), though it is much less arched, and not so ventricose. The small sinus of its lip on the convex side of the shell shows it to be the ventral side.

*Locality and position:* White Sulphur Springs, Delaware county, Ohio. Hamilton Group of Devonian Series.

## GENUS GYROCERAS, de Koninck, 1844.

(Terr. Houill., 580.)

### GYROCERAS? CONSTRICTUM, M. and W.

Pl. 12, fig. 1 *a*, *b*.

OF this species we have seen but the single specimen figured, which is merely an internal cast, consisting of a little less than one-half of a volution. It evidently increased very gradually in size from the smaller extremity, and a section of its volutions presents a transversely elliptic outline, the dorso-ventral diameter bearing the proportions to the transverse of about 20 to 30. About half of the specimen is septate, and the outer chamber appears to have been comparatively short, though its entire length is not known, as it is incomplete at the extremity. It is rather less curved than the septate part, and at about two inches from the last septum it shows a broad, shallow, undefined constriction on the outer side of the curve and the lateral margins, apparently near the aperture. The sides are rather narrowly rounded, and the inner and outer surfaces broadly so. On the outer side, however, there is some appearance of a broad, shallow, longitudinal, mesial concavity or impression, most marked on the non-septate part, near the constriction mentioned above.

On each dorso-lateral region (supposing the outer side of the curve to be the dorsal) a row of broad low nodes is seen, placed at intervals of one for about every third or fourth septum. The specimen is too imperfect to show very clearly the other prominences of the outer side, though there is some appearance of two other rows of still more obscure nodes, placed each about half-way between those mentioned and the middle, and of longitudinal ridges, though we are not quite sure that the engraving (fig. 1 *b*) represents these exactly right. On the inner side of the curve there are also several longitudinal ridges, as represented in figure 1 *a*.

On the outer side of the curve, the septa are distant from each other about one-seventh the transverse diameter, while on the inner side, they are distant about one-tenth, or one-twelfth the dorso-ventral diameter. The position of the siphuncle, and the nature of the finer surface markings, have not been determined.

We are not sure that this is a true *Gyroceras*, but merely suppose, from the curve of the fragment, that it most probably formed at least one entire turn, and hence could scarcely have been a *Cyrtoceras*. The difficulty of distinguishing these two genera, however, from such imperfect specimens, is such that a positive conclusion on this point is scarcely possible in this case.

Perfect specimens of this shell will doubtless show the nodes and ridges to be more prominent than they are on mere internal casts like that we have figured.

In the transversely elliptic form of its volutions, and some of its other characters, this species seems to have resembled *Gyroceras Logani*, Meek, from a distant northern locality on Mackenzie river, British America, but it differs in having its volutions proportionally broader, and much less tapering, as well as in the nature of its nodes and other prominences.

*Locality and position:* "Bake Oven," Jackson county, Illinois; in the Hamilton group. Devonian.

# ARTICULATA..

## *CRUSTACEA.*

### GENUS PHACOPS, Emmerich, 1839.

### PHACOPS RANA, Green, (sp.)

Pl. 11, fig. 1 *a–e.*

*Calymene bufo*, var *rana*, GREEN, 1832. Monograph Trilobites North America, p. 42.
*Phacops rana*, HALL, 1862. Report Regents University New York, Appendix D, p. 92.

ENTIRE form narrow-subelliptic, the breadth being generally about two-thirds the length; greatest breadth near the anterior part of the thorax; outline of sides nearly straight and subparallel, or converging a little posteriorly; convexity moderate. Head sub-semicircular, the posterior lateral extremities of the cheeks being a little produced backwards and narrowly rounded.

Glabella gibbous, but somewhat depressed on top and rounding off abruptly in front, with anterior lobe large or forming more than one-third of the entire bulk of the head, and about two-thirds as long as wide—separated from the palpebral lobes and eyes, on each side, by well defined furrows, that diverge rapidly forward; posterior lobes minute, and separated from the anterior by a furrow extending entirely across, but much deeper on each side than in the middle, where it usually arches a little forward; neck furrow well defined, deepest on each side, and crossing over so as to leave a narrow ridge between it and the furrow passing across between the minute posterior and large anterior lobes; neck segment or occipital ring rather wide, and nearly as prominent in the middle as the anterior lobe of the glabella. Eyes large, nearly as prominent as the anterior lobe of the glabella, and with visual faces nearly vertical or very abruptly sloping, and forming a sub-semicircular curve; lenses large, numbering five or six in the vertical, and nine or ten in the oblique rows—the upper ones usually nearly obsolete; palpebral lobes nearly as prominent as the eyes. Cheeks falling off abruptly from the eyes.

Thorax one-third longer than the head, but somewhat wider anteriorly than long; axis very nearly as wide as the lateral lobes, and a little more convex; lateral lobes flattened on top, nearly half their breadth, and then rather abruptly rounded down to the lateral margins.

Pygidium semicircular, about twice as wide as long, regularly rounded behind; middle lobe more prominent, and rather distinctly narrower than the lateral, and showing eight to about nine or ten segments; lateral lobes with seven or eight segments.

Entire surface, excepting the furrows of the head and the lapping surfaces of the pleuræ, granular—the granules being distinctly larger on the anterior lobe of the glabella than elsewhere.

Length of an adult, 1.70 inches; breadth, 1.25 inches; convexity, 0.45 inch. Other fragments indicate a size about one-third larger.

Our specimens of this species are somewhat more robust, and have a few more lenses in the eyes than specimens of *P. rana,* from the Hamilton group shale of New York, now before us; but they agree so nearly in other characters, that we see no sufficient reason for separating them.

This species is one of the types of Prof. McCoy's subgenus *Portlockia.*

*Locality and position:* "Bake Oven," Jackson county, Illinois; from the Hamilton group of the Devonian series. It also occurs in beds of the same age at New Buffalo, Iowa.

# CARBONIFEROUS SPECIES.

## FOSSILS OF THE KINDERHOOK GROUP.

## MOLLUSCA.

## BRACHIOPODA.

### GENUS RHYNCHONELLA, Fischer, 1809.

(Mem. Soc. Imp. Mosc. II, .)

### RHYNCHONELLA MISSOURIENSIS, Shumard.

Pl. 14, fig. 7 *a*, *b*, *c*, *d*.

*Rhynchonella Missouriensis*, SHUMARD, 1855. Geol. Rep. Missouri, p. 204, pl. c, fig. 5 *a*, *b*, *c*.

SHELL attaining a medium size, subtrigonal, or sometimes approaching subpentagonal, moderately gibbous, about as long as wide, or sometimes slightly wider than long; greatest breadth near the middle; posterior lateral slopes rather straight, and converging to the beaks at an angle of about 100 degrees; sides more or less rounded; front rounded, or sometimes subtruncate. Dorsal valve depressed—convex in the umbonal and lateral regions, and concave in the middle, the concavity commencing narrow and shallow, generally behind the middle, and widening and deepening to the front, so as to form a broad, shallow, rather flat mesial sinus; depressed part of the front curving downwards, and a little produced, to fill a corresponding sinuosity in the front of the other valve, the margins of the two valves meeting there, at rather less than a right angle, so that no emargination of the outline of the front is produced; beak small, rather pointed, projecting little beyond that of the other valve, over which it curves. Ventral valve considerably more convex than the other, the greatest convexity being generally in front of the middle, from which it rounds off abruptly behind and on each side, while in the middle it rises into a broad depressed, or moderately prominent, flattened or somewhat rounded, mesial prominence, rarely extending back much beyond the middle; beak incurved; cardinal margin broadly and rather distinctly sinuous on each side of the beak.

Surface ornamented by about nine to eleven broad, distinct, rounded, occasionally bifurcating plications, most of which, excepting the outer lateral ones, extend nearly to the umbones. Of these plications, three to four occupy the mesial sinus, and four to five the mesial fold, the greater number in each instance generally resulting from the bifurcation of one of the lateral ones. Distinct, rather coarse, irregular radiating striæ also mark every part of the surface, and are well defined on exfoliated surfaces, as well as upon internal casts,* while fine undulating lines, and occasional stronger marks of growth, traverse the surface concentrically.

Length of a mature specimen, 0.95 inch; breadth, 1 inch; convexity, 0.70 inch; do. of another more gibbous individual, of the same size, 0.76 inch.

Under the name *Rhynchonella Missouriensis*, it will be observed, Dr. Shumard figures two forms, differing materially in general appearance, as well as in size, and the distinctness of their plications. These he thought to be only different developments of the same species, as there were amongst the specimens some intermediate forms. The specimens from which our description was drawn up appear to agree, in all respects, with the larger one, from which his figures 5 *b* and *c* were drawn, excepting that they are not quite so gibbous, though some of them are nearly as much so. These larger, more strongly plicated shells, of which we have a good series before us, are quite constant in all their characters excepting the usual differences of convexity; and we are strongly inclined to regard them as being really a distinct species, from the smaller, more obscurely plicated shells, like that from which Dr. Shumard's figure 5 *a* was drawn. They also not only differ in size and form, but in the distinct radiating striæ of the larger shell. On well preserved specimens of the smaller type, of which we have several specimens for comparison, very faint traces of something like minute radiating striæ may sometimes be seen, by the aid of the magnifier, but they are so fine and obscure as to leave doubts whether they are not rather due to the fibrous structure of the shell, than really to surface markings, and they never leave any traces on internal casts, like the coarser unmistakable surface striæ of the larger shell.

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* These striæ are represented rather too fine and regular on the anterior part of all the figures, excepting on the mesial fold of figure 7 *d*.

The differences mentioned above are so well marked and constant, in the collections we have had for comparison, that we would scarcely hesitate to name the shell we have figured as a distinct species, were it not for the fact, that on comparing good specimens of the smaller type with authentic British examples of *R. pugnus*, of the same size, we have been unable to find any reliable differences whatever by which they can be distinguished. Indeed, they agree quite as well with small examples of *R. pugnus* as any two specimens of them agree with each other—so that we have absolutely nothing but their uniform much smaller size to distinguish these smaller shells from *R. pugnus;* and if this should not be considered a valid specific difference, then Dr. Shumard's name would have to be retained for the larger shells we have figured and described, and another name would be unnecessary. Should future comparisons of more extensive collections, however, bring to light good distinctions between the smaller, obscurely plicated and non-striated shell represented by Dr. Shumard's figure 5 *a*, and *R. pugnus*, Martin (sp.), we would propose to restrict the name *Missouriensis* to that type, and to distinguish the larger, strongly plicated and distinctly striated shell we have figured, under the name *R. striato-costata.*

It is worthy of note, here, that although the shell under consideration resembles some varieties of *R. pugnus*, particularly that to which Phillips applied the name *R. sulcirostris*, a comparison with a good series of the various forms of *R. pugnus*, sent by Mr. Davidson from Berkshire, England, shows our shell to present the following differences: In the first place, it is uniformly a proportionally narrower shell, and *always* has its posterior lateral slopes converging to the beaks at a distinctly less obtuse angle, while its plications are stronger and continued farther back, and its radiating striæ much more distinct. Indeed, there are no traces of radiating striæ on any of the English specimens of *R. pugnus* we have seen, either testiferous species or internal casts, though Mr. Davidson says well preserved examples show fine striæ on the external surface.

*Locality and position:* Kinderhook, Pike county, Illinois; Kinderhook group of the Lower Carboniferous series.

# LAMELLIBRANCHIATA.

## GENUS PERNOPECTEN, Winchell, 1865.

(Proceed. Acad. Nat. Sci., Philad., p. 125.)

### PERNOPECTEN SHUMARDIANUS, Winchell ?

Pl. 14, fig. 6 *a*, *b*. *

*Avicula circulus*, HALL, 1858. Geological Report Iowa, vol. I, part ii, p. 522, pl. vii, fig. 9; (not *A. circulus*, SHUMARD, 1855, Miſsouri Report, pl. C, fig. 14.)

*Pernopecten Shumardianus*, WINCHELL, 1865. Proceedings Acad. Nat. Sci., Philad., p. 126. Compare *A. Cooperensis*, SHUMARD, (1855), Missouri Report, pl. C, fig. 15,—? *Aviculopecten limaformis*, WHITE and WHITFIELD, (1862), Proceedings Boston Society Nat. History., vol. VIII, p. 295.)

SHELL very thin, orbicular, or subovate, the height in some examples equaling, and in others exceeding the antero-posterior diameter; valves subequal? much compressed—the greatest convexity being in the central region, and over a space narrowing thence up to the beaks, the superior lateral regions on each side being distinctly compressed or flattened, and separated from the more convex central region by two broad, shallow, undefined furrows or depressions, diverging from the beaks; ventral margin forming a semicircular curve; lateral borders less regularly rounded in outline; hinge line very short, in one valve at least, forming a retreating angle at the beaks; ears very small, subequal, distinctly flattened, more or less obtusely angular, and in one of the valves projecting above the beak, not properly defined by a marginal sinus on either side of either valve; beaks small, somewhat obtusely pointed, and scarcely projecting above the hinge line—their compressed lateral margins defined by the abrupt and distinct flattening of the ears, and diverging at an angle of about 125 degrees. Surface marked with very fine, obscure, concentric striæ, crossed, on well preserved specimens, by traces of more minute radiating striæ, which are scarcely visible without the aid of a magnifier, and curve gracefully outwards on the lateral regions.

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* We regret that our figures do not fully express the neatness of outline and symmetry of form presented by the specimens of this shell. They also fail to show the broad, shallow depressions diverging from each side of the beak, and have the lateral outlines of the umbonal region too widely diverging and not straight enough.

Height of a large, rather broad specimen, from the ventral margin to the beak, 1.10 inches; do. to top of ears, 1.18 inches; transverse or antero-posterior diameter, 1.18 inches.

In regard to the true relations of this shell to forms that have been described under several other names, we are left in so much doubt as to be considerably perplexed respecting the proper disposition to make of it. We entirely agree with Prof. Winchell, that the form for which he has proposed the specific name *Shumardianus*, is clearly distinct, even generically, from *Aviculopecten circulus*, (sp.) of Shumard, to which Prof. Hall referred it; but, on comparing our shell with Prof. Hall's figure of Winchell's type, they will be seen to differ in several respects—particularly in the straight hinge line, and obliquely truncated or straightened posterior umbonal slope of the latter.* If we were sure that the specimens we have figured, and that figured by Prof. Hall, are not *opposite valves*, we should have no hesitation in regarding them as belonging to two clearly distinct species. But as they came from the same locality and position, and it is evident, from our specimens, that the shell varied considerably in form, and it has been shown, by one of the writers (F. B. M.), in the Report on the Coal Measure fossils of Nebraska, yet in manuscript, that a rather closely allied form has the hinge line in one valve straight, and in the other forming, at the beaks, a retreating angle, we are led to suspect that the form before us and the type of the *Shumardianus*, may really be the opposite valves of the same species.

On the other hand, the species *Shumardianus*, of Winchell, agrees so nearly with *Avicula Cooperensis*, of Shumard, which we believe to be the same since described by Dr. White and Mr. Whitfield, under the name *Aviculopecten limaformis*, that we strongly suspect them all to belong to the one species *Cooperensis*. We are aware this would not be suspected, from a comparison of the particular specimen we have figured, with that figured by Dr. Shumard, which shows a few obscure, abnormally developed radiating ribs. We have had that specimen, however, and others from the same original locality in Missouri, for comparison, and know that the presence of the radiating costæ represented in Dr. Shumard's figure, is a *very* rare character in that shell, nearly all the other individuals being completely destitute of such costæ, while only one other was seen to have extremely faint traces of them. It is also worthy of note, that the radiating costæ on Dr. Shumard's figure, are, by a slight exaggeration in the engraving, made to appear too strongly defined, even for that particular specimen, on which they are most distinct. It might be thought, however, that the apparent absence of minute radiating striæ on these shells would separate them from that under consideration, but it should be remembered that the specimens upon which *Aviculopecten Cooperensis* and *A. limaformis* were proposed, are casts that would not retain such markings, while these striæ are so very minute and obscure, on most of the perfect specimens of the shell before us, that they often become obsolete and can rarely be seen without the aid of a magnifier.

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* We should state, here, that amongst our specimens of the shell here described, some individuals show indications of the straightening of the posterior? umbonal margin seen in Prof. Hall's figure.

The upper Coal Measure shell, described by Prof. Swallow under the name *Pecten aviculatus*, also agrees so closely with that here described (at least in all known external characters), as to give rise to the suspicion, notwithstanding the rather widely distinct geological horizons at which these shells occur, that they may be really the same species. Until all these questions can be settled by the comparison of good series of specimens of these several real or supposed species, we prefer to retain for our shell, provisionally, the name proposed by Prof. Winchell.

We should also state, here, that our shell is very closely allied to *Pecten Sowerbyi*, of McCoy, from the Mountain limestone of Ireland, but that species seems to have more elevated and more pointed ears, and more prominent, thread-like concentric striæ. It is extremely improbable that they belong to different genera, however.

With regard to the reference of this species to the genus *Pernopecten*, we should remark that it is only done provisionally, as we know nothing of its hinge and interior; and it was equally upon external characters alone that Prof. Winchell referred the type of the species *P. Shumardianus* to that group. The type of the proposed genus, *Pernopecten*, was *Aviculopecten limaformis*, White and Whitfield, which we have already stated, we believe to be synonymous with *A. Missouriensis*. We have never had an opportunity to see the hinge of either of these shells, but Prof. Winchell describes it as having a central triangular cartilage pit, and a transverse plate bearing, on each side of the middle, a series of smaller pits, diminishing in size from the middle outwards; and it was upon this character, chiefly, that he proposed to found the genus.*

*Locality and position:* Oolitic upper bed of the Kinderhook group, of the Lower Carboniferous, at Burlington, Iowa.

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* It is remarkable that no such peculiarities exist in *Pecten aviculatus*, of Swallow, which can scarcely be distinguished, even specifically, from the shell here described, by any external characters, while it has all the hinge characters of *Entolium*, to which I have referred it in my report on the Nebraska Coal Measure fossils, yet in MS.—F. B. M.

## GENUS PTERINEA, Goldf., 1832.

(Naturh. Atl., taf. 812.)

### PTERINEA? UNDULATA, M. and W.

Pl. 14, fig. 5.

THE only specimen of this shell we have seen consists of the two valves, opened and lying together, with portions of their margins broken away. It evidently presented an obliquely sub-rhomboid or aviculoid outline, the valves being rather compressed, oblique, and provided with strongly compressed, well developed wings or ears. The posterior ear is rather large, very flat, and separated from the swell of the umbo by a straight, oblique sulcus, most distinct in the left valve, and bordered above by a small marginal ridge, while the marks of growth show its posterior edge to be rather broadly and deeply sinuous, and its extremity somewhat acutely angular. The anterior ear is smaller, and also flat, at least in the right valve, in which it is nearly rectangular at the extremity, and rounds below into (apparently) a well defined byssal sinus, separating it from the margin below. The hinge seems to be shorter than the entire length of the valves, while the beaks are oblique and moderately convex, that of the left valve projecting a little above the hinge margin. The convex portion of the left valve is ornamented with moderately distinct, regular, concentric wrinkles and finer marks of growth, the latter of which are also faintly marked on the posterior ear. In the left valve, which is somewhat less convex than the other, the concentric wrinkles are smaller and more numerous than in the other, and not continued upon its posterior alation, though they are obscurely defined on the anterior ear.

As we only know this shell from casts of the exterior, and have not seen its hinge, of course we cannot be positively sure that it belongs properly to the genus *Pterinea*. If true Aviculas occur in these older rocks (which we doubt), it may have to take the name *Avicula* or *Pteria undulata*. Its most marked characters are the flatness of its alations and the regular concentric undulations of the convex portions of its valves.

*Locality and position:* Kinderhook group, of the Lower Carboniferous series, at Burlington, Iowa. We have also seen some imperfect casts, very similar to this species, and possibly not distinct from it, from the same horizon, at Kinderhook, Illinois. The latter are left valves, and seem to be a little more convex than in the typical example

# GASTEROPODA.

## GENUS PLATYCERAS, Conrad, 1840.*

(Ann. Report Palæont. N. Y., p. 205.)

### PLATYCERAS (ORTHONYCHIA ?) SUBPLICATUM, M. and W.

Pl. 14, fig. 4 *a*, *b*, *c*.

*Platyceras* (*Orthonychia*) *subplicatum*, MEEK and WORTHEN, 1866. Proceed. Acad. Nat. Sci., Philad., p. 265.

SHELL small, depressed conical, somewhat oblique, rapidly expanding from the subcentral apex; anterior or longer slope slightly convex; posterior and lateral slopes more abrupt, and straight or a little concave; aperture irregularly subcircular; scars of adductor muscles obliquely elongated, subovate or sublunate, and vertically striated, placed a little above the middle of each side, and connected by a linear band passing around behind. Surface unknown, but internal casts show a few large, irregular, radiating folds or plications, extending from the margins of the lip more than half way up towards the apex.

Height, 0.36 inch; antero-posterior diameter, 0.63 inch; transverse do., 0.56 inch.

We have only seen internal casts of this shell, from which it is not possible to determine whether its immediate apex was incurved or not, though it seems to have been straight, or merely oblique. The plications are large, irregular and rounded in the cast. On the exterior of the shell they were doubtless crossed by more or less distinct lines of growth.

The casts of this species are of more than usual interest, because they show distinctly that in this group of shells the muscular scars were much as in the recent genus *Capulus*.

Specifically, this shell presents some general resemblance to *P. fissurella*, of Hall, but it is smaller, less oblique, and possesses larger radiating plications.

*Locality and position:* Richfield, Ohio, from the upper part of the Waverly group; believed to be of the same age as the Kinderhook group, of the Illinois Lower Carboniferous series.

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* See page 384.

### PLATYCERAS HALIOTOIDES, M. and W.

Pl. 14, fig. 3 *a*, *b*.

*Platyceras haliotoides*, MEEK and WORTHEN, 1866. Proceed. Acad. Nat. Sci., Philad., p. 264.

SHELL rather small, very obliquely ovate and depressed; composed of about two very rapidly enlarging, nearly or quite contiguous volutions, the last one of which is depressed above, narrowly rounded on the outer side, and forms almost the entire bulk of the shell; apex of the spire on a plane with the upper side of the body of the shell; aperture large, transversely oval, being wider than high; lip sometimes a little sinuous on the outer or dorsal side; surface with moderately distinct lines of growth. Exfoliated surfaces sometimes showing faint traces of revolving striæ, apparently not seen on the external surface.

Length, 0.73 inch; breadth, 0.54 inch; height, 0.41 inch.

This species will be recognized by its very oblique depressed form, and the narrowly rounded character of the outer side of its body whorl, which peculiarities give it much the form of a *Haliotis*. Its first turn, which is quite small, seems to have been sometimes free, or slightly detached from the body of the shell, and in other examples in contact with it. The marks of growth generally indicate a rather broad, moderately deep sinuosity of the lip on the dorsal or outer side.

*Locality and position:* Same as last.

## GENUS PORCELLIA, Leveille, 1835.

(Mem. Soc. Geol. Fr., II, p. 29.)

### PORCELLIA NODOSA, Hall.

Pl. 14, fig. 1 *a*, *b*.

*Porcellia nodosa*, HALL, 1860. In loose sheets, entitled "Iowa Geological Survey, supplement to vol. I, part ii, 1859," p. 4.

SHELL very large, consisting of about four closely contiguous, slender, gradually enlarging volutions, the transverse diameter of which is a little greater than the dorso-ventral; umbilicus wide and shallow; volutions rounded on the dorsum, and prominent around near the middle of each side, where they are each provided with from 12 to 14 prominent, transversely elongated, node-like ridges; dorsal fissure narrow and deep, or apparently extending back about half way around the outer volution. Surface cancellated by fine, but distinct, regular, transverse and longitudinal raised lines, the former of which do not curve backwards as they approach the dorsal slit.

Greatest breadth, 2.27 inches; convexity, or transverse diameter of the last turn near the aperture, measuring across between the highest part of the nodes on opposite sides, 1 inch; breadth of dorsal fissure, 0.10 inch.

This fine species, perhaps one of the largest of the genus known, is apparently most nearly allied to *P. Puzo*, Leveille, from which it differs in having rather less rapidly enlarging and more rounded volutions, and a smooth surface.

*Locality and position:* Barry, Pike county, Illinois; from a peculiar cherty calcareous band at the base of the Burlington limestone, formerly supposed to belong to that rock, but now known to contain fossils characterizing the oolitic upper bed of the Kinderhook group, at Burlington, Iowa. Lower Carboniferous.

## GENUS GYROCERAS, de Koninck, 1844.

(Terr. Houill., p. 530.)

### GYROCERAS? ROCKFORDENSIS, M. and W.

Pl. 14, fig. 2 *a*, *b*.

*Nautilus* (*Cryptoceras*) *Rockfordensis*, MEEK and WORTHEN, 1866. Proceed. Acad. Nat. Sci., Philad., p. 275.

As the only specimen of this shell we have seen consists of not more than half of a volution, we are left in some doubt whether it is a *Cryptoceras* or a *Gyroceras*. Its volutions were evidently not embracing, as they are not at all concave on the inner side, but rounded all around, so as to present a slightly oval or subelliptic section, the transverse diameter of which is, to the dorso-ventral, as 132 to 110. The half volution curves around an umbilical cavity apparently rather more than half as wide as the greatest dorso-ventral diameter of the volution at the same point. The siphuncle, although not quite in contact with the dorsal side, is so near as to give the internal cast the deceptive appearance of having a small deep dorsal lobe. The septa are distant, measuring, on the dorsal side, about two-fifths the dorso-ventral diameter of the whorl at the point of measurement, and their edges pass almost directly around the whorls. (Surface, number of whorls, and aperture unknown.)

Length of a half turn, including a small portion of the last chamber, measuring around the outer side, 3.78 inches; greatest transverse diameter at the larger end, 1.80 inches; dorso-ventral do., 1.60 inches.

We are not acquainted with any other species to which this is very nearly allied, so far as we have been able to make out its characters.

*Locality and position:* Goniatite limestone, of the Kinderhook division of the Lower Carboniferous series, at Rockford, Indiana.

# ARTICULATA.

## *CRUSTACEA.*

### GENUS PROETUS, Steininger, 1830?

### PRÒETUS ELLIPTICUS, M. and W.

Pl. 14, fig. 8.

*Proetus ellipticus*, MEEK and WORTHEN, 1865. Proceed. Acad. Nat. Sci., Philad , p. 267.

RATHER small, entire outline narrow-elliptic. Cephalic shield semielliptic, about one-third wider than long, and slightly longer than the thorax—regularly and rather narrowly rounded in front and straight behind, with postero-lateral angles produced into small spines, which extend back to the fourth thoracic segment; anterior and lateral borders with a narrow marginal rim, strongly deflected upwards, and separated from the cheeks and glabella by a deep furrow. Glabella more prominent than the cheeks, including the neck segment, a little more than twice as long as wide, broader behind than in front, where it is regularly rounded, separated from the cheeks on each side by moderately well defined furrows; neck segment more prominent in the middle than any part of the glabella, about twice as wide (antero-posteriorly) as the thoracic segments, and defined by a narrower, but distinct neck furrow, the continuation of which becomes wider, but rather less sharply impressed, as it extends straight across the posterior margins of the cheeks to their lateral marginal furrows; lateral furrows of glabella, excepting the posterior ones, nearly obsolete; posterior lateral lobes small, subovate, and nearly isolated by the rather obscure lateral furrows just in front of each being directed obliquely backwards and inwards, so as to intersect the neck furrow; the other lateral lobes, of which there seem to be indications of two on each side, are very small and nearly obsolete; anterior lobe composing nearly half of the glabella. Eyes lunate, not oblique, one-third as long as the glabella, but not so prominent, situated less than their own length in advance of the posterior margin of the cheeks near the glabella, and about half their length from the lateral margins of the cheeks; reticulations very fine. Facial sutures intersecting the posterior margins of the cheeks near the middle, and extending forward from the anterior side of each eye, at first close to the side of the glabella, but soon curving outwards and obliquely forward, so as to intersect the lateral margins nearly in front of the middle of the eyes.

Thorax about one-third wider than long, distinctly trilobate; mesial lobe prominent, about once and a half as wide as the lateral lobe, consisting, apparently, of only eight segments; a little widest near the middle, and tapering posteriorly; segments not arching forward, but strongly arched upward, rather flattened. Lateral lobes depressed, somewhat flattened near the mesial lobe, and rounding down rather distinctly to the lateral margins; segments narrow on their upper edges, flattened in the direction of the axis, and bent a little backwards below the knees, apparently rounded at the extremities.

Pygidium sub-semicircular, but a little rounded at the anterior lateral angles; about one-third wider than long, and as long as the glabella, exclusive of the neck segment and anterior marginal rim; rather more broadly rounded behind than the anterior margin of the glabella; mesial lobe prominent, about as wide anteriorly as the lateral lobes, and tapering backward to an obtuse point within the margin, where it ends rather abruptly and is a little depressed, but not flattened; consisting of nine or ten moderately defined segments; lateral lobes depressed below the mesial lobe, near which they are slightly flattened, thence rounding to the margins; each with about seven rather faintly defined segments, of which only the anterior one is marked with a longitudinal furrow, all extending to within a short distance of the margin, which seems to be slightly thickened.

Surface apparently nearly smooth, excepting the glabella, which is covered with small, rather closely arranged granules. A row of very small granules may also be seen, by the aid of a magnifier, along the posterior margin of the segments of the mesial lobe, both of the thorax and pygidium.

Entire length, 0.78 inch; do. of pygidium, 0.23 inch; do. of thorax, 0.25 inch; do. of head, 0.30 inch; breadth of same, 0.39 inch; do. of thorax, 0.36 inch; do. of pygidium, 0.34 inch. Length of glabella, including neck segment, 0.25 inch; exclusive of neck segment, 0.21 inch. Length of eyes, 0.10 inch; distance of same, in advance of posterior margin of cheeks, 0.06 inch.

At a first glance this species might be readily mistaken for *P. Swallowi*, of Dr. Shumard, from the same horizon. A more careful comparison, however, at once shows it to present well defined specific differences. In the first place, the outline of the anterior margin of its head is more regularly rounded, its entire cephalic shield longer in proportion to its breadth, while its postero-lateral angles are produced into small spines. Its glabella also differs in being a little narrower anteriorly than behind, instead of the reverse, and its sides straight instead of sinuous. The posterior lateral lobe of its glabella likewise differs in being entirely isolated by the furrow just in advance of it intersecting the neck furrow, and the other lateral furrows are less distinct than in *P. Swallowi*. Again, our species differs in having its glabella granular, and the segments of its mesial lobe each provided with a row of minute marginal granules, instead of having "the whole surface minutely punctate."

It is very probable we should call this species *Phillipsia elliptica*, as it seems to present most of the characters of that genus. Unfortunately, the characters distinguishing these groups seem not to have been very clearly defined.

*Locality and position:* Jersey county, Illinois. Kinderhook group, of the Lower Carboniferous series.

# FOSSILS OF THE BURLINGTON GROUP.

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# RADIATA.

## ECHINODERMATA.

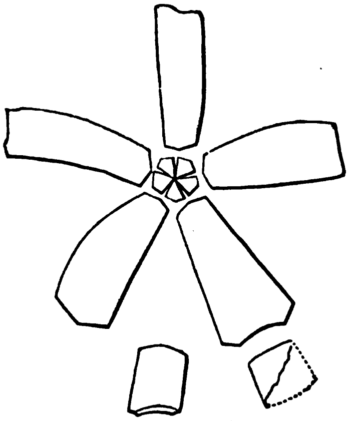
### GENUS BELEMNOCRINUS, White, 1862.

(Proceed. Bost. Soc. N. H., IX, p. 14.)

### BELEMNOCRINUS WHITII, M. and W.

Pl. 18, fig. 4 *a*, *b*, *c*.

*Belemnocrinus Whitii*, MEEK and WORTHEN, July, 1866. Proceed. Acad. Nat. Sci., Philad., p. 251.



*Belemnocrinus Whitii.*

Diagram (enlarged 2 diameters) showing body to top of subradials, including a first radial piece, and a part of the first anal.

BODY, below the summit of the subradials, ovoid-subcylindrical, and above this apparently rather rapidly expanding; rounded below. Basal pieces very small, forming a flat subpentagonal disc, as seen from below, anchylosed so as to obliterate the sutures in the specimen examined. Subradial pieces unequal, two of them narrow-oblong, or two and a-half to three times as long as wide, two about twice and a-half as long as wide, and the other narrow below, but nearly two-thirds as wide above as the entire length. First radials (or at least the only one remaining in the typical specimen) quadrangular, nearly half as long as the subradials, and slightly wider at the top than the smallest subradial; rather deeply sinuous above across its entire breadth, for the reception of the second radial. Cavity of the subcylindrical part of the body formed by the subradials, infundibuliform, the wide part above extending down about one-fourth of the length of the latter. Anal piece resting upon the slightly concave upper extremity of one of the largest subradial pieces, between two of the first radials; its form unknown. Surface nearly smooth, or merely granular.

A slightly impressed, distinctly defined, apparently obovate, flattened area seems to occupy the whole surface of the anal plate, a small portion of the upper margin of the subradial upon which it rests, and a large part of the first radial on one or both sides of the anal piece. (Column and arms unknown.)

Length of body to the summit of the first radial pieces, 0.57 inch; breadth of same at top, about 0.35 inch; do. of same at the summit of subradials, 0.25 inch.

This species differs from *B. typus*, of White, the only other known species of the genus, in its proportionally shorter and more oval form below the summit of the first radial pieces, and the greater expansion above; also in the greater inequality in the size and form of the subradial pieces; and in the peculiar flattened or impressed area in the region of the anal piece. It likewise differs in having the depression in the upper side of the only remaining first radial, for the reception of the second radial, proportionally broader; while the visceral cavity occupies near one-fourth the length of that portion of the body formed by the subradials, instead of only about one-tenth.

The specific name was given in honor of Prof. C. A. White, the able State Geologist of Iowa.

*Locality and position:* Lower bed of Burlington limestone, Lower Carboniferous series at Burlington, Iowa. Mr. Charles Wachsmuth's collection.

## GENUS CATILLOCRINUS, Troost, 1850.*

(Shumard, Cat. Pal. Foss., part 1, Echinod. p. 357, 1865 ).

### CATILLOCRINUS WACHSMUTHI, M. and W.

Pl. 18, fig. 5.

*Synbathocrinus* (*Nematocrinus*) *Wachsmuthi*, MEEK and WORTHEN, 1866. Proceedings Acad. Nat. Sci., Philad., p. 251.

GENERAL form, when the arms are folded together, elongate-cylindrical; body below the arms small, and basin-shaped, being truncated below for the reception of apparently a rather large column; thence spreading rapidly to the summit of the large radials, which are apparently soldered together, and horizontally truncated above on the same plane all around. Arms simple, very slender, in contact all around, equal and elongated; rising abruptly from the truncated summits of the large radials, and numbering altogether about thirty-five; composed each of a single series of pieces twice as long as wide, and looking very much like the tentacles of other crinoids, excepting their greater length. (Form and arrangement of the plates of the body unknown.)

Height of body, 0.12 inch; breadth about 0.30 inch; breadth of the truncation of the base, 0.14 inch; length of arms, known to be at least 1.35 inches, but probably more when entire; breadth of do., 0.03 inch.

As stated, in first describing this crinoid, the only specimen known is not in a condition to show the structure of its body—consequently we were in great doubt in regard to its generic relations. From its general appearance, we were led to think it related to *Synbathocrinus;* but from the great number and slenderness of its arms, we could not believe it belonged to the typical section of that group, and proposed to designate it, provisionally, under the subgeneric name *Nematocrinus.* At that time we had not seen a specimen of Troost's rare type *Catillocrinus*, with the arms attached, and as no species of it had ever been figured, we had no idea of its general appearance. Since that time, however, we have had an opportunity to see a specimen of *Catillocrinus* retaining a portion of its arms, and, from its similarity to the form under consideration, we can scarcely entertain a doubt but this species really belongs to Troost's genus; although we yet know nothing of the structure of its body. We therefore remove it provisionally to the genus *Catillocrinus.*

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* Troost published this name in a list in 1850; but no description of the genus was published until Dr. Shumard gave it in a foot note, in his Catalogue, in 1865.

*Locality and position:* Burlington, Iowa; from the upper part of the Burlington group of the Lower Carboniferous series.

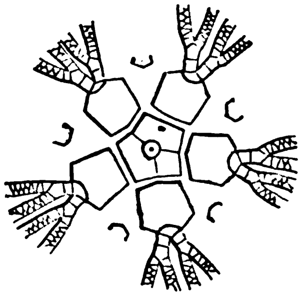
## GENUS PLATYCRINUS, Miller, 1821.*

(Nat. Hist. Crinoidea.)

### PLATYCRINUS SCOBINA, M. and W.

Pl. 16, fig. 9.

*Platycrinus scobina*, MEEK and WORTHEN, 1861. Proceed. Acad. Nat. Sci., Philad., p. 129.



*Platycrinus scobina.*
Diagram showing structure of body and arms out beyond the bifurcations. (Natural size.)

BODY rather small, cup-shaped; base basin-shaped, about twice as wide as high, and more than one-third the height of the body to the top of the first radials; pentagonal in outline, with slightly concave margins; facet for the reception of the column less than one-third the breadth of the base. First radial plates slightly broader than high, widening a little upwards from the base, and presenting a subquadrangular outline, the superior lateral angles being truncated for the reception of the anal and interradial pieces; facet for the reception of the second radial pieces not protuberant, concave, about one-third the breadth of the upper side of the first radial plates, and excavated down about one-fourth their length, or less. Second radial pieces small, triangular, and supporting on their superior sloping sides the first divisions of the arms. After dividing on the second radial pieces, the arms bifurcate again on the second piece, above which they are long, slender and simple. After the second bifurcation, they are each at first composed of a single series of wedge-shaped pieces, but gradually pass into a double alternating series of small pieces, each of which is about as long as wide. Surface of basal and first radial plates ornamented with numerous, rather sharply elevated, irregularly arranged, minute nodes, or coarse granules, so as to present a rasp-like appearance, that suggested the specific name. Sutures of the base closely anchylosed; those between the first radials well defined.

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* For a description of this genus see vol. II, p. 170, Reports Geol. Survey Illinois.

In its surface markings this species is much like *P. Wortheni* of Hall, but it differs in having a distinctly protuberant instead of a flat or concave base, and in having but four arms to each ray instead of eight or nine.

*Locality and position:* Burlington group of the Lower Carboniferous series; Burlington, Iowa. Collection of Mr. Wachsmuth.

### PLATYCRINUS PLANUS, Owen and Shumard?

Pl. 16, fig. 6.

*Platycrinus planus*, OWEN and SHUMARD, 1850. Jour. Acad. Nat. Sci., Philad., 2d series, vol. II, pl. 57, fig. 4; and (1854) Geol. Iowa, Wiscon. and Minn., p. 587, pl. 5 A, fig. 4; ?? DE KONINCK and LE HON (1854), Crinoidea Belg., p. 173, p. 5, fig. 6.

BODY large, composed of thin plates, exclusive of the arms truncato-suboval, being slightly longer than wide, and rounded below; base very large, pentagonal basin-shaped or considerably wider than high, rapidly spreading and rounding up from its rather large rounded facet for the reception of the column. First radials large, longer than wide, with a general oblong outline, and rising nearly vertically from the base; facet above, for the reception of the second radials, shallow, about one-third the breadth of the upper margins, and sub-semicircular in form. Second radials comparatively very small, wider than long, pentagonal or subtrigonal, and supporting, on their superior sloping sides, the first divisions of the arms, which each divide again on the second. Whether or not there are any other bifurcations before the arms pass into a double series of interlocking pieces, the specimens do not show very clearly, though we think there are not. Entire surface apparently nearly or quite smooth.

Height of body to top of first radial plate, 1.50 inches; breadth about 1.45 inches.

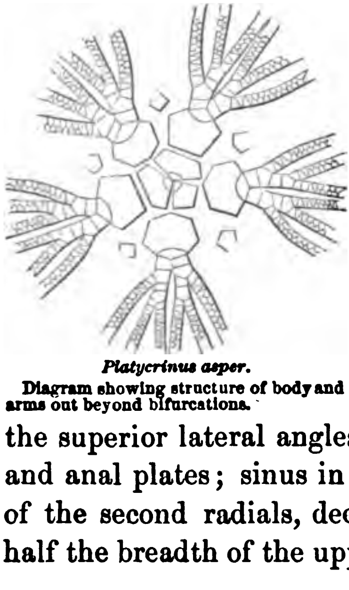
It is possible this crinoid may be distinct from that named by Owen and Shumard, but in the smooth species of this genus, when the vault and arms are removed, as was the case with Owen and Shumard's specimens, there are often so few characters left to distinguish allied species, as to render their proper discrimination very difficult. In the form we have figured, however, it is worthy of note that the excavations in the upper edges of the first radials, for the reception of the second, are more shallow than in Owen and Shumard's type. We doubt very much the identity of the Belgian form that has been referred to *P. planus*, with the American type. At any rate, the figures show it to expand much more rapidly at the top of the first radials; which also differ in having the facet for the reception of the second radials larger, and excavated down nearly half their length, thus indicating the existence of stouter and more spreading arms than in the American species. This question, however, can only be definitely settled by the comparison of more complete specimens than have yet been found.

*Locality and position:* Lower part of the Burlington group of the Lower Carboniferous or Mountain limestone, at Burlington, Iowa. Collection of Mr. C. Wachsmuth.

## PLATYCRINUS (PLEUROCRINUS) ASPER, M. and W.

Pl. 18, fig. 9.

*Platycrinus* (*Pleurocrinus*) *asper*, MEEK and WORTHEN, 1861. Proceedings Acad. Nat. Sci., Philad., p. 129.



*Platycrinus asper.*
Diagram showing structure of body and arms out beyond bifurcations.

BODY small, rather deeply basin-shaped below the arms. Base much depressed, largely and deeply excavated below, with a narrow prominent marginal rim, which is notched at the sutures, and somewhat undulated. First radial plates broader than high, widening moderately upwards and presenting a sub-quadrangular outline, but really hexagonal, in consequence of the truncation of the superior lateral angles for the reception of the interradial and anal plates; sinus in the summit of each for the reception of the second radials, deep, semicircular, and equaling about half the breadth of the upper side; surface of each ornamented by a very prominent, sharply elevated carina, which passes across near the lower side, and up the lateral margins, being waved, or often broken up into isolated prominences. Second radial pieces triangular, wider than long, and nearly entirely received within the sinus in the upper margin of the first radials. First anal and first interradial plates of apparently about the same size, the former connecting with a range of small plates above, which form the under margin of the lateral anal opening. Sutures of the body plates broadly beveled to the raised marginal carinæ.

Arms, after the first division on the second radial plates, divided again on the second piece, above which the two inner branches bifurcate again on the second piece, thus making six arms in each ray, in the specimen under examination. Above this division, the arms are slender, very gradually tapering, and each composed of a double series of small alternating pieces (excepting near the points of bifurcation), and support, on their inner sides, rather closely set ranges of tentacles. Column a little compressed, and composed of rather thin pieces, with prominent crenulated margins near the base.

This species is rather remarkable for the very prominent marginal rim around its base, as well as along the margins of the other body plates, which character imparts a rather peculiar roughness to the whole body. Although there are several other more or less similar species, we know of none very liable to be confounded with this, when all its characters are taken into consideration.

*Locality and position:* Burlington group, of the Lower Carboniferous limestone series, Burlington, Iowa. Collection of Mr. Charles Wachsmuth.

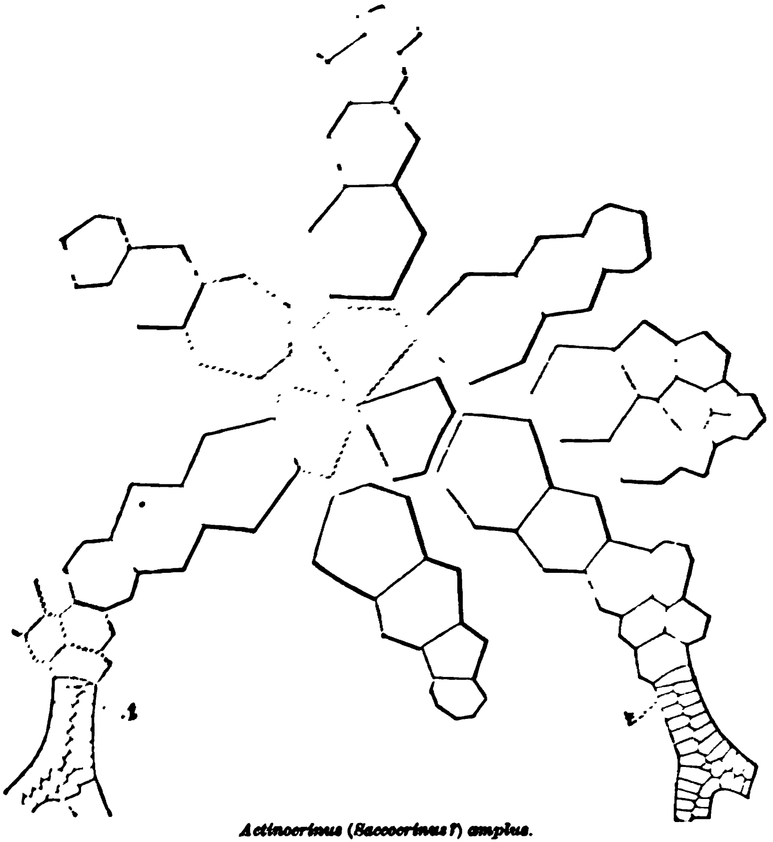
## GENUS ACTINOCRINUS, Miller, 1821.*

### Sub-Gen. Saccocrinus.

### ACTINOCRINUS (SACCOCRINUS?) AMPLUS, M. and W.

Pl. [illegible], fig. 2.

*Actinocrinus (Batocrinus?) amplus*, Meek and Worthen, 1861. Proceed. Acad. Nat. Sci. Ph[illegible], p. [illegible]



*Actinocrinus (Saccocrinus?) amplus.*

Diagram showing structure of body to third radials, and of two of the arms out to the bifurcation. (Natural size.)

Body large, urn-shaped, composed of thin, smooth or finely granular plates. Base comparatively rather small, somewhat spreading; facet for the reception of the column large, or between one-half and two-thirds as wide as the base—provided

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* For a description of this genus, see p. 147, vol. II, Report Geol. Survey Illinois.

with a small marginal rim. Column strong, round, and composed of thin segments near the body, where it has a very minute round central cavity. First radial plates rather large, a little longer than wide, hexagonal and heptagonal. Second radial plates about two-thirds as large as the first, nearly or quite as wide as long, and all hexagonal. Third radials a little smaller than the second, hexagonal and heptagonal in form, and supporting on their superior sloping sides the two first brachial pieces, which are comparatively large, and each succeeded by three or four much smaller short brachials, before the arms become free and pass into double alternating ranges of small pieces. The first anal plate is as large as the first radials, pentagonal in form, and supports two pieces in the next range, one of which is hexagonal and one heptagonal, above which there are some twelve or thirteen other smaller pieces of various forms. The first interradial plates are larger than the second radials, irregularly hexagonal, and each surmounted by two rather small pieces in the second range, and three in the next, over which there are six or seven still smaller pieces, making eleven or twelve in each interradial space.

After the division of the rays on the third primary pieces, the brachials above the first pair curve nearly horizontally outwards, but are included as a part ot the walls of the body. Beyond the fourth or fifth brachial, the free arms each pass into a double series of small alternating pieces, of which there are eight or ten in each series between the body and the first bifurcation of each free arm. Beyond this the arms are stout, rounded below, and each composed of a double series of alternating pieces, but the only specimen known is not in a condition to show whether or not they bifurcate again. Resting upon the inner sloping sides of each pair of first brachial pieces there is a rather large interaxillary piece, with three or four much smaller pieces above. The tentacles are stout, and commence at the base of the free arms, at the points marked *t*, *t*, in the diagram.

The vault is moderately convex, composed of innumerable minute pieces, and provided with a central or sub-central proboscis.

This crinoid has the general structure and arrangement of the pieces composing the body, as well as the disconnected arm bases, of the genus *Actinocrinus*, but not only differs in the elongated form of its body, from the typical species of that genus, but also in having its free arms bifurcating after they have passed into a double series of interlocking pieces. In these and other characters it seems to agree with the Upper Silurian genus *Saccocrinus*, though it is probable perfect specimens would show it to present some important differences from that group. So far as we know, it differs in the structure of its arms, mentioned above, from all of the Carboniferous types referred to the *Actinocrinus* group, excepting the so-called *A. divergens*, of Hall, from which it differs widely in all other characters.

*Locality and position:* Burlington, Iowa, in the Burlington division of the Lower Carboniferous series. The only specimens of this species we have seen belongs to the collection of Mr. Charles Wachsmuth, of Burlington, Iowa, to whom we are indebted for the use of the specimen figured.

## ACTINOCRINUS (BATOCRINUS) PISTILLUS, M. and W.

Pl. 16, fig. 4 *a*, *b*.

*Actinocrinus pistillus*, MEEK and WORTHEN, 1865. Proceed Acad. Nat. Sci., Philad., p. 152.

BODY, exclusive of the arms and proboscis, sub-pyriform; the sides rising nearly vertically from the base to the summit of the first radial pieces; thence gradually expanding to the secondary radials, after which they expand very rapidly, so as to cause the brachial pieces to be directed horizontally outwards, or nearly so, at about the middle of the body. Above the horizon of the arm bases, the dome rises at first vertically, but very soon rounds inward, and rises with a moderately convex slope to the base of the subcentral proboscis. Base truncated and flat below, with a thick dilated margin notched at the sutures, so as to present a trilobate outline, as seen from beneath; facet for the attachment of the column a little concave, and about one-third as wide as the base. Basal pieces twice as wide as high, and hexagonal in form, the inferior margin being much longer than any of the others. First radial pieces wider than long, smaller than the basal; three of them heptagonal and two hexagonal. Second radial pieces very small, twice as wide as high and transversely oblong, or sometimes with one of the superior lateral angles truncated by one of the interradials, so as to present an irregular pentagonal form. Third radials larger than the second, pentagonal or hexagonal in form, and supporting on each superior sloping side a secondary radial piece, each one of which is succeeded by another. On the superior sloping sides of the latter, in the anterior and one of the lateral rays, commence the brachial pieces, of which there are two ranges, on the last of which commence the free arms, thus giving origin to four arms in each of these rays. In the two posterior rays, however, and one of the lateral, after the second bifurcation on the last secondary radial, the latter supports on the outer sloping side a tertiary radial, which gives origin to two brachial pieces, making five arms to each of these rays, or twenty-three to the whole series.

After the first bifurcation on the third radial pieces, all the succeeding pieces of each ray are in direct contact, so as to leave no spaces for interaxillary plates; while the outer brachial pieces of each two contiguous rays connect over the anal and interradial spaces, so as nearly or quite to isolate the pieces filling those spaces, from the dome.

First anal piece of the same form as the first radials, but rather smaller than those of the anterior and antero-lateral rays; surmounted by three smaller hexagonal and heptagonal pieces in the second range, and three or four in the third, making seven or eight altogether. Interradial pieces four, (rarely five,) those of the inferior range being larger than the others.

Surface without costæ or visible granules, but roughened by the tubercular character of the plates. The tubercle occupying each first radial and the first anal, is larger than those on any of the other pieces of the side walls above, where they become smaller and less distinct with each succeeding range, until they are nearly or quite obsolete a few ranges below the arms. Upon the dome, however, the tubercles are prominent and well defined. The proboscis is unknown, but its base is stout, and rises rather abruptly from the dome, being placed nearly its own breadth nearer the anal than the opposite side.

The arms are also unknown. They evidently projected at first horizontally outwards from the body, and their bases are so crowded as to form an almost continuous rim around the body.

Height from base to horizon of arm openings, about 0.64 inch; height to base of proboscis, 1.22 inches. Breadth of dilated margin of base, 0.46 inch; breadth of same just above the rim, 0.38 inch; breadth of body at top of first radials, 0.55 inch; breadth of same at arm openings, 1.05 inches; breadth of base of proboscis, 0.43 inch.

This species is perhaps most nearly allied to our *A.* (*Batocr.*) *pistilliformis* of the Kinderhook group, from which it differs not only in having three more arms, but in the less abrupt contraction of its body immediately below the arm bases, as well as in having from four to six interradial pieces to each space, instead of only two or three. Both of these forms are related to *A. pyriformis* of Shumard, but they are readily distinguished by the much more elongated first radial pieces, as well as by the less attenuate lower part of their body, and their more convex or nodose body plates. They form together a subordinate section of the *Batocrinus* group.

*Locality and position:* Same as last.

## GENUS STEGANOCRINUS, M. and W., 1866.*

### STEGANOCRINUS PENTAGONUS, Hall, (sp.)

Pl. 16, fig. 8.

*Actinocrinus pentagonus*, HALL, 1858. Report Geol. Survey of Iowa, vol. I, part II, p 577, pl. 10, fig. 6 *a*, *b*.

*Steganocrinus pentagonus*, MEEK and WORTHEN, 1866. Vol. II, p. 196, fig. 9, Report Geol. Survey Illinois.

BODY, exclusive of the free rays and proboscis, pentagonal-subglobose, about as wide as high, more prominent below than above the horizon of the free rays. Base rather small, much wider than high, somewhat hexagonal in outline as seen from below, and without any projecting marginal rim. First radial pieces much larger than those of the base, moderately convex, three heptagonal, and two hexagonal. Second radial pieces somewhat smaller than the first, but generally nearly as long, all octagonal, and more or less curved upwards on each side to connect with the lower vault pieces. Third radial smaller than the second, heptagonal in outline, and projecting out nearly horizontally, rounded below, and very strongly curved up on each side, to connect with the pieces forming the upper side of the tubular rays; each supporting on their outer sloping sides two series of smaller pieces, which, however, do not immediately diverge, but apparently continue on out horizontally for some distance in close contact, forming the under side of each tubular ray, before the true bifurcation takes place; divisions of the free rays diverging at an angle of about sixty degrees, very long, straight, and, so far as known, continued on horizontally without farther divisions. Arms numerous, small, apparently short, and closely arranged along each side of the long straight divisions of the tubular rays. First interradial pieces about two-thirds as large as the first radials, all hexagonal, and each supporting above two somewhat smaller pieces, belonging as much to the vault as to the interradial series. First anal piece nearly as large as the first radial on each side of it, and supporting two smaller pieces in the next range, above which there are three still smaller pieces connecting with the vault.

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* For a description of this genus, see vol. II, p. 195, Reports Geol. Survey Illinois.

Vault rather depressed; proboscis of moderate size, more or less eccentric towards the anal side, and rising abruptly from the vault—composed of subspiniferous pieces. Covering pieces of free rays, with prominent nodes or short spines.

Surface of body plates, with rather strong radiating ridges, extending one from the middle of each, to each of its sides, to meet others coming from the adjacent plates; those on the first radial and first anal pieces starting from a more or less prominent central protuberance.

This extraordinary crinoid is the type upon which we proposed to found the genus *Steganocrinus.* The specimen figured belongs to Mr. Wachsmuth, and is the only example yet found with the greatly produced free rays attached. It is partly embedded in the matrix, with the upper side exposed, the proboscis, portions of the rays, and most of the true arms being broken away. By carefully working away the matrix under one side, we find it to present, so far as can be seen, the characters of *Actinocrinus pentagonus*, Hall, to which species we can scarcely doubt that it belongs. When the long rays are broken away, its body part resembles *Actinocrinus concinnus* of Shumard, in the same condition, so nearly that we suspect the latter will be found to belong to this genus when its entire rays can be seen. They certainly differ specifically, however, in the larger size and more robust growth of *A. concinnus*, which also has more ornately rayed body plates.

This species seems also to be related specifically to our *S. araneolus*, which, however, differs in being smaller and much more depressed.

*Locality and position:* Same as last.

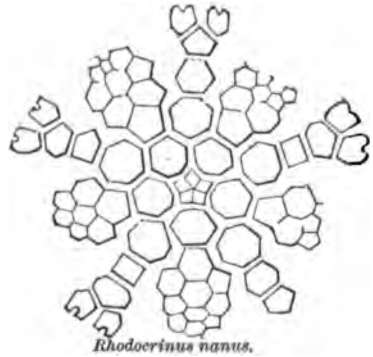
## GENUS RHODOCRINUS, Miller, 1821.*

(Nat. Hist. Crinoidea.)

### RHODOCRINUS NANUS, M. and W.

Pl. 18, fig. 2 *a*, *b*.

*Rhodocrinus nanus*, MEEK and WORTHEN, July, 1866. Proceed. Acad. Nat. Sci., Philad., p. 254.



*Rhodocrinus nanus.*

Diagram showing structure of body out to arm bases. (Enlarged two diameters.)

BODY small, subglobose, with nearly vertical sides which round under below to the basal concavity. Base very small, and entirely concealed in the concavity of the under side, by the end of the column. Subradial pieces comparatively large, forming the under side of the body, and curved up so as to show nearly half the surface of each in a side view, hexagonal in general outline, but probably each with a seventh nearly obsolete angle at the middle of the side connecting with the base. First radials nearly as large as the subradials, and regularly heptagonal in form; second radials rather more than half as large as the first, normally hexagonal, but sometimes pentagonal, and rarely quadrangular; third radials generally larger than the second, wider than long, pentagonal, hexagonal or heptagonal, and supporting upon their superior sloping sides, apparently the first brachial pieces, which are not free, but support the first free pieces in the next range; if there were no farther divisions of the free rays, there must therefore have been two arms to each ray, or ten in the entire series. First interradials smaller than the first radials, and resting upon the truncated upper sides of the subradials, regularly hexagonal in form, or rarely with the superior angle slightly truncated by the middle piece of the next range, so as to form a seventh angle; second range consisting of two, or rarely three, rather smaller generally hexagonal pieces, above which there are five or six other still smaller pieces connecting with the vault between the arm bases, thus making some eight or nine interradials to each area; anal pieces about the same number as in each interradial space, but a little larger in size and differently arranged, there being three pieces in each of the ranges above the first one, the middle ones of which continue on up in a right line to connect with the base of the proboscis above. Vault depressed to the level of the upper side of the arm bases, and provided with deep broad furrows or depressions radiating from near the middle to the interradial spaces, composed of small, irregular, rather tumid pieces. Opening of the summit at the end of a short, rather narrow lateral proboscis, which rises vertically, with its outer side nearly on a line with the vertical side of the anal area.

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* For remarks on the relations of this genus to *Gilbertsocrinus*, Phillips, see p. 217, vol. II, Reports Geol. Survey Illinois.

All the body plates are convex in the middle, from which point very obscure ridges radiate to each of their sides. The greater convexity and larger size of the radial pieces impart a somewhat pentagonal outline to the body, as seen from above or below. The surface is somewhat granular, and the column, which is composed near the base of alternately thicker and thinner pieces, is round, and pierced by a minute rounded cavity.

Height of body, 0.33 inch; breadth of do., 0.35 inch.

This neat little species is evidently closely allied to *R. Barrisi*, of Hall, from which it differs in having its body plates merely convex and provided with radiating ridges, instead of being "ornamented by sharp, angular nodes and spines;" also in having eight or nine interradial pieces to each area, instead of only four to six. Another difference is to be observed in the size of the third radial pieces, which in *R. Barrisi* are "minute," while in our species they are as large as the second radials. We only know the *R. Barrisi* from the published description, but we have been assured by Mr. Wachsmuth, who compared the form under consideration with authentic examples of that species, that they are easily distinguished.

*Locality and position:* Lower division of the Burlington group of Lower Carboniferous limestone series, at Burlington, Iowa.

## Genus BURSACRINUS, M. and W., 1861.

(*βυρσα*, a purse; *χρινον*, a lilly, in allusion to the purse-like form of the typical species, as seen with its arms folded together.)

*Bursacrinus*, Meek and Worthen, June, 1861. Proceed. Acad. Nat. Sci., Philad., p. 136; White (1862), Proceedings Boston Soc. Nat. Hist., vol. ix, p. 11.

*Generic formula.—*

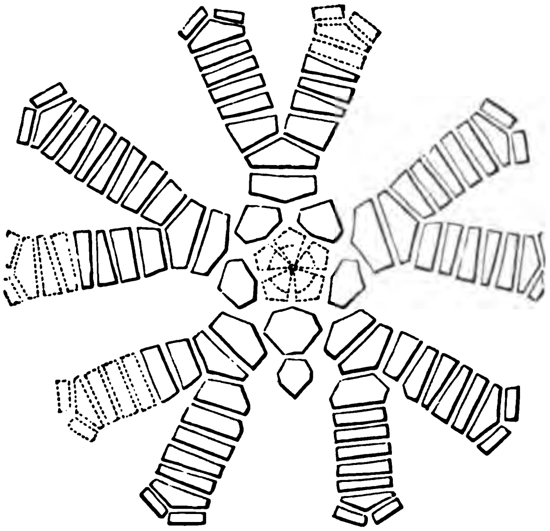
Basal plates, 5.
Subradial plates, 5; four hexagonal and one heptagonal.
Radial plates, 2 + 5.
Interradial plates, 0.
Arms ten, bifurcating.

This genus has much the appearance of *Woodocrinus*, de Koninck, being, like that type, provided with five basal pieces, five subradials, and two pieces to each of the primary radial series; as well as in having about six broad, short pieces to each of the arms below their first division. It differs, however, materially in having but a single anal piece, instead of 18 to 20. Like *Woodocrinus*, it has the arms broad and flat, and connected all around so as to leave no spaces for interradial pieces. The only two species known are from the Burlington group of the Lower Carboniferous limestone series. (Type B. Wachsmuthi, M. and W.)

## BURSACRINUS WACHSMUTHI, M. and W.

Pl. 17, fig. 6.

*Bursacrinus Wachsmuthi*, MEEK and WORTHEN, June, 1861. Proceedings Acad. Nat. Sci., Philad., p. 187.



*Bursacrinus Wachsmuthi.*
Diagram showing structure of body and rays out to second bifurcation. Nat. size.

BODY below the summit of the first radial plates turbinate, or obconical. Basal pieces unknown. Subradial plates of moderate size, a little wider than long, and all hexagonal, excepting one on the anal side, which is larger than the others, and heptagonal in form; the angles at the middle of the under side of each being less salient than that above. First radial plates about one-third larger than the subradials, near twice as wide as high, and all pentagonal, the upper side being transversely truncated. Second radial pieces of the same size and form as the first, but of course with the sloping sides above instead of below; supporting on their superior sloping sides the first divisions of the arms, which are broad, flat, and connected laterally with each other all around. Anal piece rather small, longer than wide, heptagonal, the angle at the middle of the summit being more salient than the others; supported upon the short truncated upper side of one of the subradials, and connecting on each side with the first and second radial plates, and the first of the arm pieces above.

After the first division on the second radials, the arms bifurcate again on the sixth or eighth piece, above which one is seen to bifurcate again on the twelfth piece, which is as far as they can be traced, in the only specimen seen, though they seem to be long, and probably bifurcate once or twice more above.

Between the first bifurcation of the rays on the second radial pieces, and the next division above, the arms are very wide, flat, and composed of short, slightly wedge-formed pieces, which are squarely truncated on each side. The next divisions above these are a little less than half as wide, and composed each of a single series of pieces, bearing near the same proportions of length and breadth as those below. The surface is finely granular, though there are no traces of nodes, costæ or other prominences on any of the plates. The sutures are merely linear, and not impressed.

The specific name of this crinoid was given in honor of Mr. Charles Wachsmuth, of Burlington, Iowa, who discovered the only specimen of the species we have seen.

*Locality and position:* Same as last.

# CYATHOCRINUS, MILLER, 1821.*

(Nat. Hist. Crinoidea, p. 85.)

## CYATHOCRINUS ENORMIS, M. and W.

Pl. 16, fig. 3 *a*, *b*.

*Poteriocrinus? enormis*, MEEK and WORTHEN, 1865. Proceedings Acad. Nat. Sci., Philad., p. 137.
*Cyathocrinus enormis*, M. and W., 1865. Ib., p. 152.

BODY small, below the arms, irregularly cup-shaped; sides somewhat convex, expanding from the base; breadth greater than the height. Base small, spreading from the column, above which the plates are seen presenting small pentagonal faces. Subradial plates comparatively large, unequal, hexagonal in form, excepting one on the anal side, which is larger than the others, and subpentagonal in outline. First radial plates larger than the subradials, longer than wide, and irregularly subhexagonal or heptagonal; facet for the reception of the second radials small, shallow, and about one-third as wide as the plates. Arms above the first radial pieces slender, cylindrical, and composed of a single series of segments, from twice to three or four times as long as wide. In some of the rays the first division takes place on the second, in others on the third, and in the anterior ray, on the fourth piece above the first radials; after which they bifurcate irregularly once, twice, or oftener, on the second, third or fourth piece. The first anal plate is rather large, and rests upon the upper truncated side of the largest subradial plate, so as to project considerably above the first radials—its left side curving inwards, and its right connecting with another anal plate of nearly its own size, resting upon a sloping side of the first radial on the right. Above these are seen several other plates, which form, together, a kind of slender lateral proboscis, rounded on its outer side, and rising like an arm on a range with the true arms. Some little distance above its base, the

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[*] For a description of this genus see page 175, vol. II, Reports Geol. Survey, Illinois.

proboscis curves abruptly inwards between the arms, leaving at its left base apparently a cavity or opening in the vault, passing into the body between it and the arm on that side.

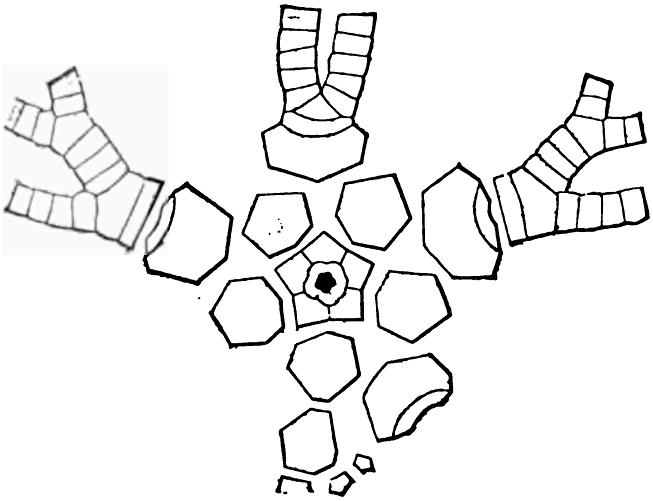
**In the arrangement of the plates composing the body, as well as in the characters of its arms, this little crinoid agrees most nearly with *Poteriocrinus;* but instead of having its body produced above in the form of a large elongated trunk or proboscis, composed of small hexagonal pieces, as in that genus, it has merely a very small lateral proboscis, not larger than one of the arms, with apparently another independent opening in the vault, more nearly as in *Cyathocrinus.* As these characters are probably of more importance than the more or less variable differences in the number and arrangement of the anal plates and the structure of the arms, observed between *Poteriocrinus* and *Cyathocrinus*, we have been led to transfer this species from the former to the latter genus.**

***Locality and position:*** **Same as last.**

## CYATHOCRINUS WACHSMUTHI, M. and W.

**Pl. 16, fig. 5.**

***Cyathocrinus Wachsmuthi*, MEEK and WORTHEN, 1861. Proceed. Acad. Nat. Sci., Philad., p. 186.**



*Cyathocrinus Wachsmuthi.*

Diagram illustrating structure of body and arms out to second bifurcation. The first radial pieces are in part as if flattened out. The quadrangular subanal piece was accidentally omitted from the space near the left upper side of the first true anal, in the diagram, (right lower side in the fossil).

BODY, below the summit of the first radials, broad obconic. Base of moderate size, low and distinctly pentagonal, the angles formed by the extremities of the plates being a little incurved;

facet for the column covering about one-third to one-fourth of each basal piece. Column obscurely pentagonal near the base, the angles being rounded; central canal comparatively large and pentagonal. Subradial plates five to six times as large as the basal pieces, about as long as wide, three of them hexagonal, and two on the anal side heptagonal, all indented or incurved at the sides and at the upper angles. First radials larger than the subradials, unequal in size, and wider than long; all heptagonal in consequence of the truncation of the upper lateral angles, apparently for the reception of small interradial or vault pieces, each having the angles below distinctly indented, and the upper side truncated and moderately concave for the reception of the succeeding plates. Second radials very short or nearly linear, and considerably wider than long. Third radials generally a little narrower and longer than the second, and more or less nearly triangular or pentagonal in form. Subanal piece of variable size, quadrangular, and indented at the angles; first true anal plate larger than the subanal piece, hexagonal or subpentagonal, resting upon a short upper truncated side of one of the subradials, and connected on each side with the first radials, while its right inferior sloping side rests against the subanal piece. The arms, after dividing on the third radials, are strong and rounded on the outer side; one of the divisions in each of the rays, excepting the anterior one, bifurcates again on the fourth pieces. All the divisions and subdivisions are rounded, gradually tapering, and composed each of a single series of pieces, as long as wide, or a little longer, and give off at intervals of two or three pieces, alternately on opposite sides, rather strong jointed lateral divisions, which extend obliquely outwards and bifurcate several times. Surface apparently merely irregularly granular, but on a close examination, traces of very small, radiating, slightly raised lines are seen on the subradial and radial plates, as well as passing up the principal divisions of the arms.

The specific name of this fine crinoid was given in honor of Mr. Charles Wachsmuth, of Burlington, Iowa, to whom we are indebted for the use of the only specimens of the species we have seen.

*Locality and position:* Same as last.

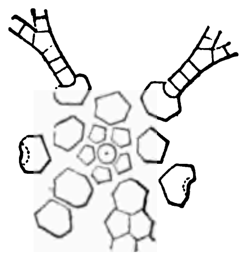
## GENUS POTERIOCRINUS, Miller, 1821.*

(Nat. Hist. Crinoidea.)

### POTERIOCRINUS TENUIBRACHIATUS, M. and W.

Pl. 16, fig. 1.

*Poteriocrinus tenuibrachiatus*, MEEK and WORTHEN, 1861. Proceed. Acad. Nat. Sci., Philad., p. 138.



*Poteriocr. tenuibrachiatus.*

Diagram (enlarged to 1½ diam.) showing structure of body out to first radials, inclusive, and of two of the rays a little beyond to the first bifurcation.

BODY small, cup-shaped, or subturbinate below the summit of the first radial plates. Base forming a low, pentagonal, saucer-shaped cup, composed of small pieces, showing each a pentagonal outline above the column. Subradial plates comparatively large, about as wide as long, three hexagonal and two, on the anal side, heptagonal, and a little longer than the others. First radial pieces somewhat larger than the subradials, wider than long, and pentagonal in form; facet for the reception of the second radials moderately prominent, a little concave, and from one-half to two-thirds the breadth of the plate. Anal plates, three—the first hexagonal, and resting between the upper sloping sides of two of the subradial pieces, while another on the left rests against this, and upon the superior truncated side of one of the subradials. A third piece is supported on the upper side of the lowest anal piece, and projects more than half its length above the radial on its right. The succeeding primary radial pieces, after the first, are much smaller, and generally a little wider than long. In all, excepting the anterior and one of the anterior lateral rays, where the bifurcation takes place on the fifth plate, the first division of the arms is on the fourth primary radial. Above this the arms, which are very long, slender and rounded, divide again on the fourth piece, after which the divisions bifurcate three or four times, and become very attenuated. Each division is composed of a single series of pieces, usually about twice as long as wide.

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* For a description of this genus see p. 179, vol. II, Reports Geol. Survey Illinois.

The proboscis connects directly with the anal plates already described, and is made up of hexagonal plates, along the sutures of which vertical ranges of distinct, rather large pores are seen. Entire surface finely granular. Sutures linear, and not grooved or impressed.

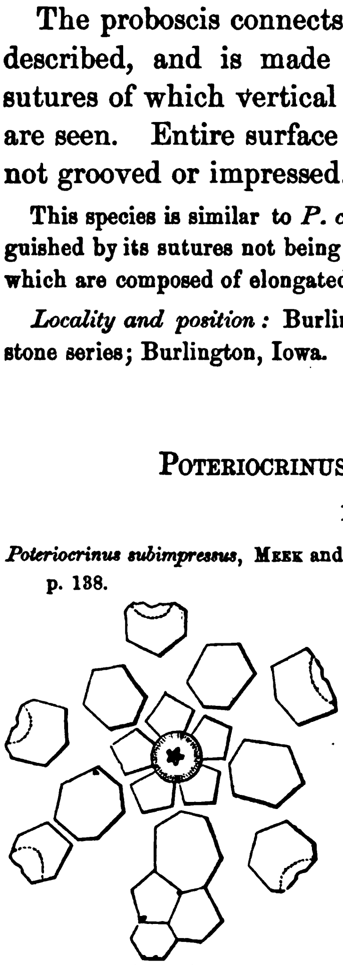
This species is similar to *P. calyculatus* of Hall, but may be at once distinguished by its sutures not being excavated, and by its much more slender arms, which are composed of elongated, instead of short, wedge-formed pieces.

*Locality and position:* Burlington group, of the Lower Carboniferous limestone series; Burlington, Iowa. Mr. Wachsmuth's collection.

## POTERIOCRINUS SUBIMPRESUS, M. and W.

Pl. 18, fig. 1 *a*, *b*.

*Poteriocrinus subimpressus*, MEEK and WORTHEN, 1861. Proceed. Acad. Nat. Sci., Philad., p. 138.



*Poteriocrinus subimpressus.*
Diagram (nat. size) showing structure of body to the first radial pieces, inclusive.

BODY obconical. Base forming a shallow cup about twice as wide as high, expanding moderately from the summit of the column; composed of plates about as high as wide, and pentagonal in form, the angle at the middle of the upper side of each being a little indented. Subradial plates comparatively large, somewhat larger than wide, two of them heptagonal and three hexagonal. First radials a little smaller than the subradials, wider than long, pentagonal or in part hexagonal, and all truncated above for the reception of the second radials. First anal plate slightly larger than the basal pieces, pentagonal, and resting between the upper sloping sides of two of the subradial pieces; second anal piece of the same size as the first, hexagonal in form, and resting upon the upper truncated side of one of the subradials, while its left side connects with one of the first radials, and its right with the first anal piece, and a third hexagonal piece supported by the latter. (Succeeding parts unknown.)

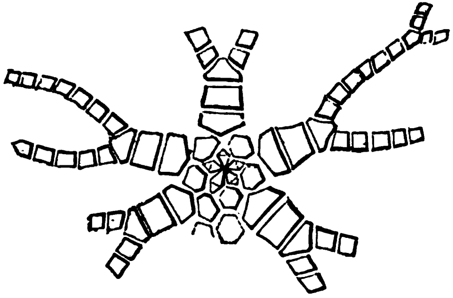
The column is round, and comparatively stout at its connection with the base, near which it is composed of rather thin segments of uniform size; central perforation of moderate size, and presenting a pentagonal section. The surface seems to be granular, and the subradial pieces show a very slight tendency to develop short, broad, obscure, radiating prominences near the sutures on each side, and below as well as sometimes at their connection with the first radials above. Sutures at the corners of the subradial and anal pieces more or less distinctly indented.

*Locality and position:* Burlington group, of the Lower Carboniferous limestone series, at Burlington, Iowa. Collection of Mr. Wachsmuth.

## POTERIOCRINUS CARINATUS, M. and W.

Pl. 17, fig. 1.

*Poteriocrinus carinatus*, MEEK and WORTHEN, June, 1861. Proceed. Acad. Nat. Sci., Philad., p. 189.



*Poteriocrinus carinatus.*

Diagram (enlarged three diameters) showing structure of body and arms.

BODY small, basin-shaped, or rather rapidly spreading below the arms. Base very small, having the form of a pentagonal star, the angles of which project but slightly beyond the column. Subradial pieces small, about as wide as long, four of them hexagonal (the form of that on the anal side not seen); all rather prominent, and provided with a vertical carina near the upper angle. First radial pieces about twice as large as the subradials, as wide again as high, and pentagonal in form, the upper side being transversely truncated and longer than either of the others. Second radials slightly larger than the first, wider than high, quadrangular, and a little constricted around the middle. Third radials about the size of the first, or smaller, pentagonal in form, and, like the second, slightly constricted, the upper angles being rather salient. The anal plates are not all preserved in the specimen before us, though we can see that the first piece is of moderate size, pentagonal in form, and extends so far down between two of the subradials as to connect (apparently) by a very short side, with the produced extremity of one of the basal pieces. Its right superior sloping side supports one edge of a first radial above, and evidently supported another piece on its superior truncated edge, while it connects on the left with another resting on the upper truncated side of one of the subradials.

After the first division on the third radials, some of the arms bifurcate again on the fifth, sixth, or seventh piece, while others seem to be simple. They are all composed of pieces which are a little constricted around the middle, as long as wide, and alternately longer and shorter on opposite sides, the upper extremity of the longer side of each being a little projecting for the reception of the tentacles, so as to give a slight zigzag appearance to the arms. The tentacles are comparatively large, and composed of rather long joints. Owing to the length of the arm pieces, and the fact that only every alternate piece on the same side supports a tentacle, they are very widely separated and alternately arranged.

The surface seems to be granular, and each ray is provided with a distinct linear carina, commencing on the middle of each first radial piece and extending along each division of the arms to the extremities. The sutures between the primary radials seem to be a little gaping, as in *Scaphiocrinus*, to which the species appears to bear some relations in other respects, though it differs in having three primary radials to each ray.

The anal side of the specimen examined being imperfect, we are left in some doubt in regard to the generic characters of this species. In some respects it seems to agree more nearly with *Cyathocrinus* than with the typical forms of *Poteriocrinus*, though it evidently possessed more anal pieces than the former genus. The carinated character of its arms and primary radial pieces, is a peculiarity that will readily distinguish it from any otherwise similar species with which we are acquainted.

*Locality and position*: Same as last.

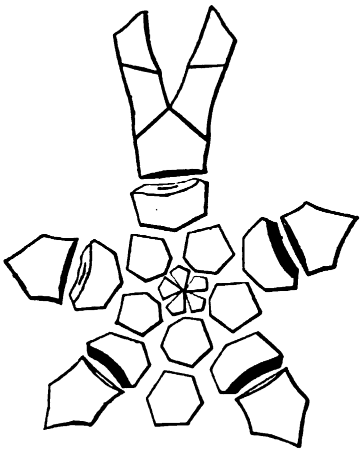
## SUBGENUS SCAPHIOCRINUS, Hall, 1858.

(Geol. Report Iowa, 1, part II, p. 550.)

### SCAPHIOCRINUS WACHSMUTHI, M. and W.

Pl. 16, fig. 7 *a*, *b*.

*Poteriocrinus* (*Scaphiocrinus*) *Wachsmuthi*, MEEK and WORTHEN, 1861. Proceed. Acad. Nat. Sci., Philad., p. 141.



*Scaphiocrinus Wachsmuthi.*

Diagram (enlarged 2 diam.) showing structure to second radials, inclusive, and in one ray the commencement of the arms. The ring showing the size of facet of column was omitted on the basal pieces by the engraver.

BODY small, inversely bell-shaped below the summit of the first radial plates, nearly twice as wide as high. Base small, little exposed in a side view, and not projecting much beyond the column, which is rounded and composed of rather thin segments near the body. Subradial plates about as high as wide, somewhat convex, four hexagonal, and one heptagonal. First radial plates from one-third to one-half larger than the subradials, wider than long, truncated above, and pentagonal in general form, the upper side being longer than the others, and the superior lateral angles more or less truncated. Second radial pieces somewhat larger than the first, distinctly constricted around the middle, about as long as wide, or sometimes longer, and pentagonal in outline, the superior angle being rather acute. First anal plate larger than the subradials, hexagonal in form, resting upon the truncated upper side of one of the subradial pieces, and projecting nearly half its length above the first radial plates on each side. Arms, after the second division on the second radial pieces, apparently simple, very long, and gradually tapering; each composed of a single series of joints, all of which are longer than wide, somewhat constricted around the middle, and alternately longer and shorter on opposite sides, the upper extremity of the longer side of each projecting out for the reception of the tentacles, so as to give the arms a zigzag appearance. Tentacles strong, and composed of joints twice to three times as long as wide, and very profoundly grooved on the inner side. Surface finely granular. Sutures well defined, with, at the corners of the subradial plates, particularly on the anal side, deep rounded pits.

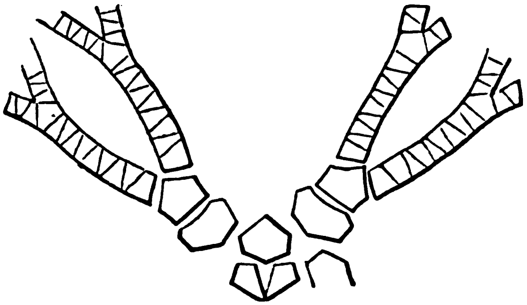
This species seems to be related to *S. spinobrachiatus*, Hall, but differs in the form of its body, and in having longer arm pieces, which are also without the spines seen on those of that species. It has remarkably long arms, and a very neat bell-shaped body, below the top of the first radials.

*Locality and position:* Burlington group, of the Lower Carboniferous limestone series, at Burlington, Iowa. Collection of Mr. Wachsmuth.

## POTERIOCRINUS (SCAPHIOCRINUS) TENUIDACTYLUS, M. and W.

Pl. 18, fig. 10.

*Poteriocrinus* (*Scaphiocrinus*) *tenuidactylus*, MEEK and WORTHEN, 1865. Proceedings Acad. Nat. Sci., Philad., p. 156.



*Scaphiocrinus tenuidactylus.*
Diagram (natural size) showing structure of one side of body, and of arms to bifurcations.

BODY, in comparison with the length of the arms, small, inversely campanulate below the summit of the first radial pieces—being narrowly rounded below, and rather expanded above, where the breadth is nearly twice the height. Base less than half as wide as high, basin-shaped, the sides rounding under to the facet for the reception of the column, which is of medium size and a little concave. Basal pieces well developed, pentagonal, and wider than long. Subradial pieces twice or three times as large as the basal; those on the anterior side (the only ones seen) hexagonal. First radials wider, but shorter than the subradials; transversely truncated about three-fourths their entire breadth above, for the reception of the succeeding radial pieces; those on the anterior side curving a little outwards and having an irregular pentagonal outline, the superior lateral angles being more or less truncated, or rounding inwards. Second radials pentagonal, nearly as long as wide, rounded and constricted around the middle, with the central superior angle prominent, and the sloping margins on each side of it supporting the arms.

Anal pieces unknown. Arms long, slender, and in two of the anterior rays known to bifurcate on the tenth piece above the second primary radials, after which they are seen to be extended to a considerable length, without showing distinctly another division, though there is some appearance of such bifurcation in one of the branches, on the twentieth piece. Immediately after the division of the rays on the second primary radials, the arms are rounded and composed of wedge-shaped pieces, wider than long, and alternately thicker and thinner on opposite sides, each one supporting at its larger end a stout tentacle. Above the bifurcation, the divisions are very long, slender, somewhat angular on the outer side, and still composed of a single series of wedge-shaped pieces, each one of which is strongly protuberant laterally, for the reception of a tentacle at its larger end, the protuberances alternating on opposite sides, so as to give the arms a zigzag appearance, somewhat like those of *Platycrinus nodobrachiatus*, Hall. Surface apparently smooth, or only finely granular. Sutures not impressed between the plates of the body, but somewhat gaping between the first and second radials.

Height of body to the top of first radials, 0.41 inch; breadth, 0.60 inch. Length of arms to first bifurcation, 0.80 inch; entire length, including arms, more than 3 inches.

This species seems to be related to several of those described by Prof. Hall, from the same locality and position, but on comparison will be found not to agree, in all its characters, with the description of any of them. From his *S. spinobrachiatus* it evidently differs in not having the plates of the body convex, nor the sutures indented at their angles, as well as in the absence of spines on its arms, while its body is less broadly expanded. From *S. Whitei*, Hall, it differs in not having the "surface of the cup marked by deeply impressed pits," at the junction of the sides of the subradials, and between the first radial pieces; and from *S. Halli*, Hall, it differs in not having the arms simple after the first division on the second primary radials, as well as in some of the details of their divisions.

*Locality and position:* Same as last.

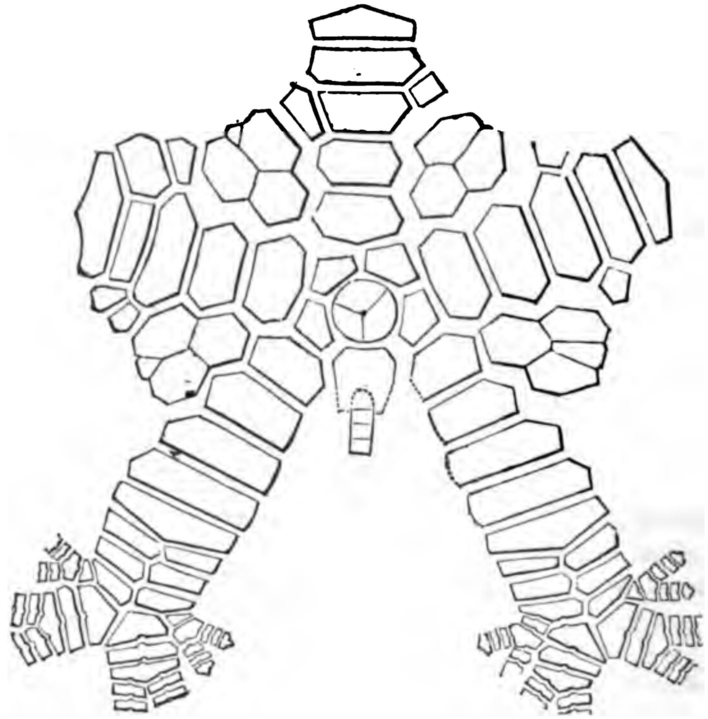
## GENUS ONYCHOCRINUS, Lyon and Casseday, 1859.*

(Am. Jour. Sci. (2), xxix, p. 77.)

### ONYCHOCRINUS DIVERSUS, M. and W.

Pl. 17, fig. 5 *a*, *b*.

*Onychocrinus diversus*, MEEK and WORTHEN, July, 1866. Proceed Acad. Nat. Sci., Philad., p. 256.



*Onychocrinus diversus.*
Diagram (nat. size) showing structure of the body, and of two of the rays out to arms. The free radial plates are represented as if flattened out, which makes them appear wider than natural.

BODY and rays forming together an irregular five-rayed star, the body being comparatively small and depressed, and distorted by the deeper excavation of the anal side; while the rays are large, stout, rigid and free, from the second radial pieces outward, and extend out horizontally on the same plane with the base. Basal pieces hidden by the column, or merely showing as a thin ring, scarcely distinguishable from the last segment of the column, when the latter is attached. Subradial pieces comparatively rather large; four of them equal, wider than long, and all pentagonal, with the upper sloping sides longer than the lateral margins; the fifth one larger (particularly longer) than the others, and apparently hexagonal. Radial pieces five to each ray, thick and strong, and after becoming free on the second pieces, curving strongly up on each side, so as to make the underside of the free rays distinctly rounded; first radial pieces considerably larger than the subradials, of rather unequal size, wider than long, and heptagonal in form, with probably the exception of one or two of those on the anal side, which appear to be truncated on the lower side, so as to be hexagonal in outline. Succeeding radials diminishing gradually in length, the second, third and fourth being wider than long, hexagonal, pentagonal or rarely quadrangular in form, but all transversely oblong, as seen from below; while the fifth is pentagonal, as seen from beneath, having an obtuse middle angle on the outer side. Beyond this the rays are each composed of a double series of strong pieces, which are slightly disposed to assume an alternating arrangement, the two series continuing in close contact laterally to the fourth, then diverging abruptly at an angle of 90° to 100°, to form distinct rounded branches. At the outer bases of these branches an arm is given off on each side on the third piece from the commencement of the double series, and bifurcates so as to form a bunch of small armlets; beyond this the two main divisions of the rays continue on, each composed of a single range of pieces, until the third piece beyond the lateral arms just mentioned, after which they are each composed again of a double series of pieces, on the third of which another arm is thrown off on each side, and bifurcates as before. After this each main branch bifurcates without much divergence of the subdivisions, which are short and divided, so as to form together a bunch of small bifurcating arms, thus making altogether apparently not less than several hundred rounded armlets, or ultimate division of the rays, to the entire series.

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* For remarks on this genus, see vol. II, p. 242, Reports Geol. Survey Illinois.

The rounded armlets are all short, and form clusters at the extremities of the divisions of the horizontally extended strong rays, where they curve upwards, and fold together in bunches like the fingers of a clenched fist. They are each composed of a single series of small pieces, which are wider than long, with a minute patelliform piece at the under side of each, as in *Forbesiocrinus.*

Interradials three or four to each space, with others above belonging apparently more properly to the vault; first interradial pieces hexagonal and resting in a notch between the upper sloping lateral margins of the subradials. Anal series, as far as known, consisting of a single free row of very small pieces resting upon the upper side of the largest subradial, so as to present much the appearance of an abortive armlet. Surface merely finely granular, with the exception of a small linear ridge along the middle of each armlet.

Height of body, exclusive of vault, 0.80 inch; antero-posterior diameter, 0.90 inch; transverse diameter, 1.40 inches; greatest transverse diameter between the extremities of opposite rays, 4 inches; length of each of the two main divisions of each ray, 0.85 inch. Column, at its connection with base, 0.28 inch in diameter, and composed of pieces only 0.01 inch in thickness, or ten to the tenth of an inch.

We have not seen any specimen of this species showing the vault, but we are inclined to believe it extended out over the free rays to the point where their divisions diverge, if not further, as in *Steganocrinus.*

In the second volume of Illinois Geol. Reports, we stated that we had never seen a specimen of this genus showing how the little arm-like range of anal pieces connected with the vault and the radials on each side. Since that time we have seen a fine specimen of Lyon and Casseday's typical species, showing this space to be occupied by numerous very minute pieces.

This species is related to *Onychocrinus asteriformis*=(*Forbesiocrinus asterisformis*, Hall), but differs in attaining a much larger size, as well as in having the two main divisions of each ray widely divergent and proportionally longer, instead of nearly parallel. Again, it differs in having the subdivisions and armlets much more numerous; also in having always five primary radial pieces to each ray.

If reliable characters should hereafter be discovered for separating generically *Taxocrinus* from *Forbesiocrinus*, it may be found necessary to range *Onychocrinus* as a subgenus under the latter, in which case the name of the species here described would become *Forbesiocrinus* (*Onychocrinus*) *diversus*.

*Locality and position:* Same as last.

## GENUS TAXOCRINUS, Phillips, 1843.*

(Morris' Cat. Brit. Foss., p. 90.)

### SUBGENUS FORBESIOCRINUS, de Kon. and Le Hon, 1854.

(Rech. Crin. Carb. Belg , p. 118.)

### FORBESIOCRINUS AGASSIZI, var. GIGANTEUS.

Pl. 18, fig. 3.

?*Forbesiocrinus Agassizi*, HALL, 1858. Iowa Report, vol. I, part II, p. 680 (without description); Supplement to same (1865), p. 65.

*Forbesiocrinus Agassizi*, var. *giganteus*, MEEK and WORTHEN, June, 1861. Proceed. Acad. Nat. Sci., Philad., p. 131.

THIS large crinoid differs from the typical example of *F. Agassizi*, Hall, in having four, instead of three plates in each of the secondary radial series, while there are some differences in the number and arrangement of the anal and interradial plates. It also differs in having its column almost exactly cylindrical for a distance of at least four inches below the base, while that of *F. Agassizi* is described as "rapidly tapering below the summit." We suspect it may be distinct from the species described by Prof. Hall, but as it seems to agree with his description and diagram in most of its characters, excepting the points of difference we have mentioned, we have merely placed it as a variety of that species, until its relations to *F. Agassizi* can be determined from a comparison of specimens. Should it be found to be specifically distinct, it can take the name *F. giganteus*, or rather *Taxocrinus* (*Forbesiocrinus*) *giganteus*, for we believe these groups so intimately blended together by intermediate types, that they can only be separated as subgenera.

It is perhaps the largest species of this type known, and must have had a very large number of ultimate divisions of its free arms, which are proportionally short.

*Locality and position:* Same as last.

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* For a description of this genus see vol. II, p. 268, Reports Geol. Survey Illinois.

## GENUS GRANATOCRINUS (Troost), Hall, 1852.[*]

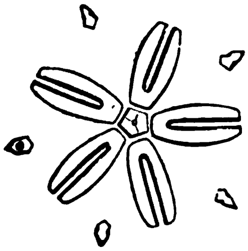
(List Crin., Proc. Am. Assoc. Cambr. meeting, p. 62, 1850.)

### GRANATOCRINUS PROJECTUS, M. and W. (sp.)

Pl. 18, fig. 7.

*Pentremites melo*, var. *projectus*, MEEK and WORTHEN, 1861. Proceedings Acad. Nat. Sci., Philad., p. 142.

*Granatocrinus melo*, var. *projectus*, SHUMARD, 1866. Trans. St. Louis Acad. Sci., vol. II, p. 375.



*Granatocrinus projectus.* Diagram showing structure. (Natural size.)

THIS form is very much like *G. melo*, Shumard = (*Pentremites melo*, Owen and Shumard), but differs in having its base proportionally a little larger, and projecting so as to be distinctly seen in a side view, instead of being concave. Its pseud-ambulacral areas are also not continued down quite so near the base of the radial or fork-pieces, as in *G. melo;* while its small anal piece is more prominent. In first noticing it, we supposed it to be merely a marked variety of *G. melo*, but subsequent examinations of a large number of specimens of that species, in various conditions, have led us to the conclusion that it is a distinct species.

The figure given on plate 18 represents the typical specimen, enlarged to twice the natural diameter.

*Locality and position:* Same as last.

### GRANATOCRINUS NORWOODI, O. and S? (sp.)

Pl. 18, fig. 8.

*Pentremites Norwoodi*, OWEN and SHUMARD, 1860. Jour. Acad. Nat. Sci., Philad., 2d ser., vol. II, p. 64, pl. 7, fig. 13; Geol. Report Iowa, Wisconsin and Minnesota, p. 591, pl. 5 A, fig. 13.

*Elæacrinus Norwoodi*, SHUMARD, 1865. Trans. St. Louis Acad., vol. II, p. 112.

*Granatocrinus Norwoodi*, SHUMARD, 1866. Ib., p. 375.

THE fossil we have figured under the above name belongs to Mr. Wachsmuth, of Burlington, Iowa, who found it in the Burlington group of the Lower Carboniferous series, at that place. So far as we know, it is the only example of any species of the *Granatocrinus* group, yet found, with the numerous little thread-like arms attached. As might have been expected, from the affinities of this type to *Pentremites*, these arms are in all respects similar to those of that genus. About thirty of them can be counted arising from each pseud-ambulacral area, though this is probably not the whole number, as they are folded together so that many of them are doubtless hidden from view. They are very slender, simple, of uniform size, without any perceptible taper, and composed each of a single row of pieces as long as wide, of which about seven may be counted in the space of 0.10 inch. We are not sure that any of them are entire, though it is evident that those attached near the lower part of the areas must be twice as long as the body. The column is round near the base, and composed of thin pieces of equal size; but further down, they are alternately smaller and larger, at regular intervals.

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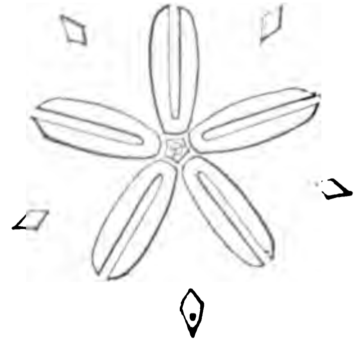
[*] Troost published the name *Granatocrinus*, for this group, in 1850, in a catalogue without a description. In 1852, Prof. Hall adopted it, and gave some remarks on its affinities in the Fifteenth Ann. Report Regents Univ. N. Y., p. 146. For farther remarks on this genus, see vol. II, p. 274, Reports Geol. Survey Illinois.

The body of the specimen is partly hidden by the arms, but as far as can be determined, it seems to agree so nearly with *G. Norwoodi*, that we have referred it provisionally to that species. At the same time, we can see that it presents some differences, which have led us to suspect that it may possibly be specifically distinct. In the first place, the parts of its radial pieces, forming the interambulacral spaces, are not more than half as wide as in specimens of *G. Norwoodi*, of the same size. These surfaces also slope inwards laterally, so as to form a rather deep groove along the suture between each two radial pieces, instead of forming a flat area across between the pseud-ambulacra, as in *G. Norwoodi*. Again, its pseud-ambulacral areas are proportionally nearly twice as wide as in *G. Norwoodi*, while the portions of the surface exposed are more coarsely granulated than is usual in that species, and the granules are somewhat differently arranged. We have elsewhere proposed, that in case it should be found distinct from *G. Norwoodi*, as we suspect it will be, to designate it as *G. fimbriatus*.

## GRANATOCRINUS SHUMARDI, M. and W.

Pl. 18, fig. 6 *a?*, *b.**

*Granatocrinus Shumardi*, MEEK and WORTHEN, 1866. Proceed. Acad. Nat. Sci., Philad., p. 257.



*Granatocrinus Shumardi.*
Diagram (nat. size) showing structure.

BODY elliptic-oval, the length and breadth being as about 67 to 44. Base having the form of a nearly flat pentagonal disc, with moderately prominent angles; facet for the attachment of the column round, and a little more than half as wide as the base. Radial pieces narrow subelliptic, or nearly three times as long as wide, most projecting and slightly narrower at the lower extremity, and nearly flat between the pseud-ambulacral areas, along the margins of which they project abruptly in the form of a prominent sharp carina; equaling five-sixths the entire length of the body, and each obliquely truncated on each side above, for the reception of the interradials. Pseud-ambulacral fields very narrow, extending very nearly the entire length of the body, with almost exactly parallel sides; rather convex, and each with a moderately distinct longitudinal mesial linear furrow, on each side of which about 65 pore pieces may be counted; lanceolate and supplementary pore pieces unknown. Interradial pieces about one-fourth the entire length of the body, rhombic in outline, or widest in the middle, and tapering nearly equally to the upper and lower extremities; all rather distinctly sloping inwards from the lateral angles to the middle, so as to present a notched appearance on their outer surfaces. (Openings of the summit unknown.)

Surface showing, by the aid of a good magnifier, in a cross light, microscopic longitudinal lines, near the lower end of the radial pieces, and on the interradials, much stronger lines parallel to their inferior sloping sides.

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* We are in some doubt whether the figure 6 *a*, here referred to, is a view of the under side of this species, or of *G. projectus*, not having access to the specimens at the time these descriptions are passing through the press.

Length, 0.67 inch; breadth, 0.44 inch.

At a first glance this species might be mistaken for the common *G. melo*, of Owen and Shumard, from which it may be readily distinguished by several well marked characters. In the first place, it is narrower in proportion to length, and differs in having its pseud-ambulacral areas prominent instead of sunken, and bounded on either side by a sharply elevated carina; while its interambulacral areas are flat, or even a little concave, towards the lower part of the body, instead of being convex. It likewise differs in having scarcely a visible line, instead of a deep furrow along the sutures between the radial pieces; while its base is much larger, and not sunken, but on a level with the lower ends of the radial pieces, which are likewise more protuberant at their lower ends.

In its larger and more prominent base, this species agrees more nearly with *G. projectus*, from which, however, it differs in all the other peculiarities mentioned. Compared with the species *P. elongatus*, of Shumard, which it resembles in general form, it will be at once distinguished by its greatly narrower and more prominent pseud-ambulacral areas, larger radial pieces, and proportionally larger interradials, which extend up to near the center of the summit. These two forms may be regarded as the connecting links between the true *Pentremites* and the *Granatocrinus* group. *P. elongatus*, however, falls clearly into the former, while the form under consideration belongs to the latter genus.

The specific name of this fine species was given in honor of Dr. B. F. Shumard, of St. Louis, Missouri, who has given more attention to the *Blastoidea* than any other person in this country.

*Locality and position:* Burlington group of the Lower Carboniferous series, at Burlington, Iowa. Mr. Wachsmuth's collection.

# ASTEROIDEA.

## GENUS SCHŒNASTER, M. and W., 1860.*

### SCHŒNASTER WACHSMUTHI, M. and W.

Pl. 17, fig. 4.

*Schœnaster Wachsmuthi*, MEEK and WORTHEN, July, 1866. Proceedings Acad. Nat. Sci., Philad., p. 259.

BODY flattened or much depressed, with a regular, distinctly pentagonal outline, the angles being produced into five rather attenuated rays, which are a little convex above, and apparently as much as two-thirds as long as the diameter of the disc, if not more. Disc concave in outline on the margin between the rays, and imparting a slightly alate character to the latter by extending a little along their margins; like the dorsal side of the rays, composed above of numerous small, slightly convex plates. Dorsal pores moderately distinct between the plates. Plates of the under side of the disc about as large as those of the dorsal side, but flattened, scale-like, crowded, and having the inward imbricating character of the genus strongly marked. Ambulacra (as seen in a compressed specimen) very narrow, their marginal plates moderately large, oval-oblong, comparatively thin, and very strongly imbricating outwards. Between these, two rows of short, flattened, spine-like scales are seen arising from the ambulacral furrow, and all inclining outwards or towards the extremities of the rays. (Other characters unknown.)

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* For a description of this genus, see p. 277, vol. II, Reports Geol. Survey Illinois.

Diameter of disc, 1.32 inches; rays apparently extending as much as 0.90 inch or more beyond the margins of the disc.

This species will be readily distinguished from our *S. fimbriatus*, of the St. Louis limestone, the only other species of the genus known to us, by its smaller and less convex plates on the dorsal side, as well as by its much thinner, less oblique and more strongly imbricating row of plates along each side of the ambulacra, and particularly by its much narrower ambulacral furrows. We have not seen any traces of the row of short flattened marginal spines seen around the disc of *S. fimbriatus*, in the form under consideration; nor have the similar little appendages arising in a double row from the ambulacra of the latter been seen in *S. fimbriatus*. These, however, may be rather generic than specific charaeters, and consequently be found common to both species.

The specific name is given in honor of Mr. Charles Wachsmuth, of Burlington, Iowa, the discoverer of the only specimen we have seen.

*Locality and position:* Same as last.

# MOLLUSCA.

## POLYZOA.

### GENUS EVACTINOPORA, M. and W., 1865.

(Proceed. Acad. Nat. Sci., Philad., p. 165.)

POLYZOUM free? consisting of a few large, more or less thickened, and solid calcareous plates or laminæ, radiating from an imaginary vertical axis, so as to present, in a transverse section, a star-shaped or cruciform outline. Rays thickest and most dense on the under and outer edges, thinner and penetrated on each side by the pores within; each apparently divided along the middle by a thin lamina, separating the inner ends of the pores of the opposite sides; substance showing, in transverse sections, a more or less laminated structure, the laminæ being arranged parallel to the planes of the rays. Pores small, regularly arranged in quincunx, and separated by spaces equaling or exceeding their own breadth.

Type *E. radiata*, M. and W.

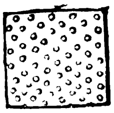
Since first proposing this genus, we have been led to suspect that it may possibly not be distinct from *Conodyctium*, of Munster; but as we have no good description or specimens of that genus at hand for comparison, and it is generally believed not to date back beyond the Jurassic period, in Europe, we have concluded to retain our name, provisionally, until the relations of our type to *Conodyctium* can be settled by a comparison of specimens. The fact, however, that the rounded end in our typical species (turned upwards on the plate) has the edges of all the rays thick and solid, while they become very thin as far as they can be traced towards the other extremity, certainly indicates that this rounded, thickened extremity is the inferior part of the fossil, as it is very improbable that it would have rested upon the thin edges of the rays, whether free or attached. Hence it would seem to have differed, in this respect, from *Conodyctium*, in which the larger rounded end is the upper extremity, while below it apparently tapers to a narrow base of attachment.

The three species we have here described are, so far as we have been able to ascertain, the only known examples of the genus (unless it is not distinct from *Condyctium*), and two of these, at least, came from the Burlington division of the Carboniferous limestone series, while the other is from the Lower Carboniferous, and, as we have reason to believe, from the same beds.

## EVACTINOPORA RADIATA, M. and W.

Pl. 17, fig. 2 *a*, *b*.

*Evactinopora radiata*, MEEK and WORTHEN, August, 1865. Proceedings Acad. Nat. Sci., Philad., p. 165.



*Evactinopora radiata.*
Pores enlarg'd about 2 diam.

POLYZOUM oval or subglobose, rounded below; rays eight, moderately thick, solid, and subcarinate on their free edges and much thinner within; pores of moderate size, round, occupying only the thin portions of the rays; regularly disposed, and separated by spaces equaling their own breadth, sometimes with margins apparently slightly raised.

Greatest transverse diameter across from the extremities of opposite rays, 0.90 inch; diameter of the nucleus formed by the union of the rays, 0.35 inch; thickness of the rays on the outer margin near the nucleus, 0.10 inch; do. of the thin poriferous portion, 0.03 inches; diameter of the pores, 0.02 inch.

This is the typical and smallest known species of the group, and also has the largest number of rays. We have not seen any specimen of it entirely free from the matrix, and consequently do not know the exact form of the whole fossil. It is probable, however, that the thin poriferous portions of the rays were produced so as to give the whole an oval form.

Our figure 2*b* was inadvertently drawn with the rounded part, which we believe to be the lower side, turned upwards.

*Locality and position:* The only specimen of this species we have seen is from the Lower Carboniferous limestone series of Missouri, but its exact locality and position is unknown.

## EVACTINOPORA SEXRADIATA, M. and W.

Pl. 17, fig. 3.

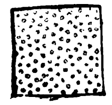
THIS species we only know from a transverse section of a specimen embedded in the matrix. It will be readily distinguished, however, from the last, by having only six, instead of eight rays. Its rays are also proportionally longer and narrower, and differ in being abruptly thinner at their connection with the nucleus, as well as at their outer edges.

It is possible the number of rays may be a variable character, but with our present means of comparison, we can but regard this as a distinct species from the last.

*Locality and position:* Same as last.

## EVACTINOPORA GRANDIS, M. and W.

Pl. 15, fig. 2 *a*, *b*.



*Evactinopora grandis.* Pores enlarged about two diameters.

ATTAINING a very large size; but moderately convex below. Rays four, very long, and extending out at right angles so that as seen in a transverse section they present the form of a cross; moderately thick and rounded or subangular on the under edge, decreasing in thickness gradually upwards, and from their outer margins inwards, sometimes flexuous below; entire height unknown. Pores small, round, and regularly arranged in quincunx, at intervals of about twice their own breadth apart; extending inwards a little obliquely, from each lateral surface of the rays.

Figures 2 *a* and 2 *b* merely represent transverse sections of this fossil, as seen broken across, in the matrix. On the other side of the specimen represented by figure 2 *a*, however, the under side of the fossil is seen, showing the lower edges of the rays to be about 0.27 inch in thickness, rounded or obtusely angular, and rather strongly and irregularly flexuous. The height from the base to where the specimen is broken across, so as to show the section figured, is 1.30 inches, but it is probable that the entire height was much greater than this. Weathered transverse sections show some evidences of a mesial lamina along the middle of each ray between the inner ends of the pores of the two opposite sides. There are also some indications of an imperfect laminated structure in the whole of the solid substance of the rays penetrated by the pores, the laminæ being arranged parallel to the sides of the rays; and on following them in to where the four rays meet, they do not cross or end there, but those belonging to any one side of one of the rays curve out, and may be traced into the nearest side of the next ray.

This is evidently by far the largest species of this group known, and also differs from the others in having but four rays. As we have not met with an entire specimen, we have no certain means of knowing its full size, but one ray of one of those figured can be traced out to a length of 3.25 inches, at which point it is broken off. The entire transverse diameter was probably not less than seven inches. There are no traces of a scar of attachment below.

*Locality and position:* Burlington group of the Lower Carboniferous series, at Burlington, Iowa.

## GENUS FENESTELLA, Lonsdale, 1839.

(Murchison's Silurian Syst.)

## SUBGENUS LYROPORA, Hall, 1856.

(Proceed. Am. Assoc., Albany, p. 179.)

### FENESTELLA (LYROPORA) RETRORSA, M. and W.

Pl. 15, fig. 1.

OF this species we only know the solid marginal support from which the expanded, reticulate portion has been entirely removed. The two divisions of the lateral support diverge at an angle of ninety degrees, and are comparatively straight and slender. As in other species of this group, they have their inner edges oblique, and not parallel to the plane of the fossil, while the minute, attenuated base of attachment is deflected towards the same side as the inner edges of the lateral marginal supports.

As we know nothing of the nature of the foliated expansion, that extended across like a net-work, between the diverging solid portions of this species, not much can be said in regard to its relations to the few described species of the group. It seems to be most nearly similar to *F.* (*Lyropora*) *subquadrans*, of Hall, from the Chester Limestone, but differs in having the little point of attachment deflected in the opposite direction, and the two lateral branches more widely diverging.

In regard to the importance of the characters distinguishing the genus, or subgenus, *Lyropora*, from *Fenestella* and *Polypora*, there is room for some difference of opinion. It would certainly seem that a peculiarity in the mode of growth, imparting so striking a difference to the general appearance of the whole fossil, as that distinguishing these forms, ought to be regarded as being at least of subgeneric importance. Yet when we examine the delicate net-work extending across between the solid divisions of the support in *Lyropora*, we find it presents in structure, and the arrangement of the animal cells, in some species, exactly the characters of *Fenestella*, and in others those of *Polypora*, as is the case in *Archimedes*, so that if we admit *Archimedes* and *Lyropora* to be good genera, we must include in each, species that present, in all excepting the mode of growth, the characters of both *Fenestella* and *Polypora*. On the other hand, if we admit the latter two types as being generically distinct, we must, on the same characters, divide *Lyropora* and *Archimedes* each into two distinct genera.

*Locality and position:* Same as last.

# BRACHIOPODA.

## GENUS CHONETES, Fischer, 1837.

(Oryct. Mosc.)

### CHONETES ILLINOISENSIS, Worthen.

Pl. 15, fig. 8 *a*, *b*.

*Chonetes Illinoisensis*, WORTHEN, 1860. Trans. St. Louis Acad. Sci., vol. I, p. 571.
*Chonetes Logani*, HALL, 1858. Iowa Geological Report, vol. I, part II, p. 598, pl. 12, fig. 1 *a–e*, and 2; not *C. Logani*, NORWOOD and PRATTEN (1854), Journal Acad. Nat. Sci., Philad , vol. III, p. 30, pl. II, fig. 12 *a*, *b*, *c*.

SHELL attaining a moderate size, transversely semioval, rather compressed; length generally a little more than two-thirds the breadth; lateral margins somewhat straightened behind, and usually intersecting the hinge nearly at right angles, but rounding to the front, which forms a broad semielliptic curve; hinge nearly or quite equaling the greatest breadth. Ventral valve most convex in the central and umbonal regions, and without a mesial sinus in front; ears somewhat compressed; area narrow; cardinal margin with five or six oblique spines on each side of the beak. Dorsal valve with concavity decidedly less than convexity of the other valve. Surface ornamented with numerous fine, closely arranged, round, dichotomous striæ, of which from one hundred to one hundred and twenty or more may be counted around the free margin of each valve.

Length of a medium sized individual, 0.47 inch; breadth of do., 0.65 inch; convexity of same, 0.13 inch; number of striæ in the space of 0.10 inch, at the free margin, twelve to fourteen.

By some oversight, Prof. Hall referred this shell, in the Iowa Report, to *C. Logani*, of Norwood and Pratten, from which it differs greatly in the fineness and much larger number of its striæ—*C. Logani* having only about thirty striæ to each valve, while in the shell under consideration there are from three to four times that number. It is much more nearly allied to *C. Shumardiana*, de Koninck, with which we are unable to compare it, not having any authentic specimens, nor any figure or description of that species at hand. Prof. Hall states that it differs from *C. Shumardiana* in being more coarsely striated, and in not having the fine granulations so characteristic of that shell.

The shading of our enlarged profile figure 8*b*, makes the shell look proportionally too convex.

*Locality and position:* Jersey county, Illinois; Burlington division of the Lower Carboniferous limestone series. Also, at same horizon at Burlington, Iowa; and in the Kinderhook group at Wassonville, Iowa.

# GASTEROPODA.

## GENUS METOPTOMA, Phillips, 1836.

(Geol. Yorks., ii, p. 228.)

FROM Phillips' figures, and very brief description of the genus *Metoptoma*,* it is evident he intended to include in it only those patelliform palæozoic shells with the posterior side more or less truncated. Mr. Billings, however, and some others, extend it so as to include circular or oval species, showing no traces of the posterior truncation, such as were referred by Phillips and others to *Patella*. Although it seems probable that the typical truncated forms and the oval or circular species without the posterior truncation, represent two distinct genera, it is perhaps practically impossible, in our present state of knowledge, to separate these groups, owing to the fact that there are so many intermediate forms; while it is very rarely, indeed, that we can have an opportunity too see the internal characters of these shells.

Phillips says nothing respecting the muscular impressions of his typical species, but his figure of his *M. oblonga*, which seems to represent an internal cast, shows apparently a horse-shoe shaped scar, like that seen in *Capulus*, *Hipponyx*, and the allied genera. Prof. de Koninck has also shown (Supp. to An. Foss. Belg., pl. LVIII, fig. 1 and 2) this scar very clearly in *M. pileus*, of Phillips, and *M. solaris*=(*Patella solaris*, de Kon.) From these figures it is evident, as observed by Prof. de Koninck, that the open end of the horse-shoe shaped scar is directed away from the truncated end of the shell, showing that the truncated margin is the posterior, instead of the anterior, as had been supposed by Phillips.

### METOPTOMA? UMBELLA, M. and W.

Pl. 15, fig. 6 *a*, *b*, *c*; and 7.

*Metoptoma* (*Platyceras?*) *umbella*, MEEK and WORTHEN, 1866. Proceedings Acad. Nat. Sci., Philad., p. 267.

SHELL much depressed, patelliform, circular; apex central, or very nearly so; sides sloping about equally, with generally a slight concavity, in all directions; surface marked by fine lines and obscure wrinkles of growth. Muscular scar on each side, elongate-oval, and somewhat arched downwards, with a narrower band connecting them behind; aperture very large and nearly circular.

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* "Patelliform, face under the apex truncated."

Length and breadth each about 1.70 inches; height, about 0.70 inch.

Although not a very uncommon shell, we have never seen a specimen of this species with the apex entire, though in some of the casts there is an appearance of its having been somewhat abruptly attenuated, and possibly curved. Hence we are not quite sure that it may not be more properly a greatly expanded *Platyceras*, since we now know that genus has similar muscular scars. It is much more depressed and expanded, however, than any species certainly known to belong to that genus, with which we are acquainted. In general, the specimens are regularly circular, or very slightly oval, and they are always without any traces of the peculiar truncation of the typical forms of *Metoptoma*, though some of them seem to show obscure indications of it in the slightly less prominent outline of the margin on one side.

One of the specimens (represented by figures 6 *a*, *b*, which is somewhat weathered), apparently agreeing with the others in other respects, shows some appearances of small, irregular, interrupted radiating costæ, especially on one side, apparently the anterior. This may possibly be specifically distinct from the others, but we cannot be sure of this without more specimens for comparison, since the typical specimens are mostly casts.

Prof. Winchell has described, from the Kinderhook beds at Burlington, Iowa, a somewhat similar species, under the name *Metoptoma undata* (see Proceed. Acad. Nat. Sci., Philad., July, 1865, p. 131), but, judging from his measurements, it must be distinctly less depressed than our shell, and differs in being "contracted at the aperture."

*Locality and position:* Burlington division of the Lower Carboniferous Limestone series, at Quincy, Illinois; also at same horizon on Honey creek, Henderson county, Illinois.

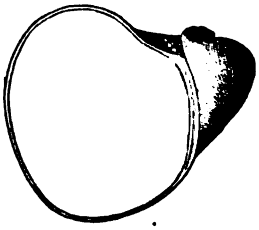
## GENUS PLATYCERAS, Conrad, 1840. (See p. 384.)

(Ann. Report Palæont. N. Y., p. 205.)

### PLATYCERAS [?] REVERSUM, Hall.

Pl. 15, fig. 4 *a*, *b*, and annexed cut.

*Platyceras reversum*, HALL, 1860. Appendix to Supplement of Iowa Report, volume I, part ii, p. 8.



*Platyceras ? reversum.*
Cut showing the aperture, columella and spire.

SHELL transversely subovate, ventricose; volutions about one and a-half, increasing very rapidly in size from the apex; spire small, sinistral, depressed below the upper side of the body of the shell, and flattened and carinate near the apex, and closely incorporated with the inner lip, so as to form a kind of rudimentary columella; body volution very large; aperture large and subcircular. Surface with rather obscure striæ and faint undulations of growth.

Greatest transverse diameter, 1.30 inches; height (which is also the height of the aperture), 1.10 inches; breadth of aperture, 0.95 inch.

As remarked by Prof. Hall, this shell departs from the typical forms of *Platyceras*, in having some appearances of a columella, as well as in having its spire decidedly sinistral. In addition to this, the upper side of the spire, near the apex, is remarkably flattened, and distinctly carinated at the outer edge of the flattened space. On one specimen, this carina or ridge is continued spirally from the apex to near the middle of the body of the shell, gradually becoming more obtuse and less marked as it recedes from the point of the spire. In examining the flattened apex of these shells, the inquiry naturally suggests itself whether they may not have commenced their growth attached by this part of the shell to marine bodies? If so, their habits must have been entirely different from those of *Platyceras*.

On clearing away the matrix from the inner lip, since figure 4 *b* (which does not represent this part of the shell correctly) was drawn, we find there is an obscure, but unmistakable columella. It is not broad and twisted as in *Strophostylus*, but narrow, and furrowed along its entire length, as if for the support of an operculum. The whole aspect of the shell is exceedingly like that of some of the small spiral forms of *Exogyra*, in which the cardinal area is very narrow and very oblique, though we have no doubt in regard to these shells belonging to the *Gasteropoda*.

If the peculiarities mentioned should be regarded as of generic importance, we would suggest for this type the name *Exogyroceras*, from its resemblance to *Exogyra*. It is also possible that the species *P. biserialis*, which appears to be sinistral, will be found to present essentially the same characters, although it differs in the possession of spines.

In our figure 4 *a*, the spire is made to appear as if disconnected from the body of the shell, which is not the case, however, in the specimen.

*Locality and position:* Burlington group of the Lower Carboniferous limestone series, at Boonville, Missouri.

## PLATYCERAS BISERIALIS, Hall.

Pl. 15, fig. 3 *a*, *b*.

*Platyceras biserialis*, HALL, 1860, Contributions to the Palæontology of Iowa, p. 90.

SHELL obliquely subovate, expanding rapidly from the apex; spire small, apparently not making more than one volution, and coiled nearly on a plane, though its apex, which is not well exposed to view in the specimen, has the appearance of being sinistral; aperture subcircular or broad-oval; lip somewhat irregular, deeply sinuous on the dorsal side. Body portion armed on each side by about four to six long tubular spines, arranged in rows, and directed outward nearly at right angles to the surface. Surface marked by fine striæ of growth, strongly undulated near the aperture, parallel to the irregularities of the lip.

This is, so far as we are aware at this time, the only shell resembling *Platyceras*, yet found in our Carboniferous rocks, that is provided with spines. It seems to differ from the Devonian spiniferous species, in having the spines very regularly arranged in a row on each side of the body part of the shell, instead of being irregularly scattered over the whole surface.

*Locality and position:* Burlington group of the Lower Carboniferous limestone series, at Quincy, Illinois.

## PLATYCERAS [ORTHONYCHIA] QUINCYENSE, McChesney.

Pl. 15, fig. 5 *a*, *b*.

*Platyceras Quincyensis*, McCHESNEY, 1861. Descriptions of New Palæozoic Fossils, p. 90; 1865, Illustrations of same, pl. vi, fig. 6 *a*, *b*.

*Platyceras Quincyense*, McCHESNEY, 1867. Transactions Chicago Acad. Sci., vol. I, p. 49, pl. vi, fig. 6.

SHELL obliquely conical, narrowing regularly from the aperture, apparently entirely straight; sides with five broad ridges radiating from the apex to the aperture; ridges regularly disposed, and each flattened or slightly concave along its middle, and separated from those on each side by rather deep, rounded furrows. Surface markings unknown. Aperture with a general subcircular form, but showing a tendency to a pentahedral outline.

As this species has only been found in the condition of internal casts, with the apex broken away, we have no means of determining the nature of its surface markings, or whether its immediate apex was straight or curved. From the general appearance of such casts as have been found, however, the shell seems to be straight throughout all its length. Its most marked character is the presence of five strong, more or less furrowed ridges, extending its whole length.

*Locality and position:* Same as last.

# FOSSILS OF THE KEOKUK GROUP.

# RADIATA.

## ECHINODERMATA.

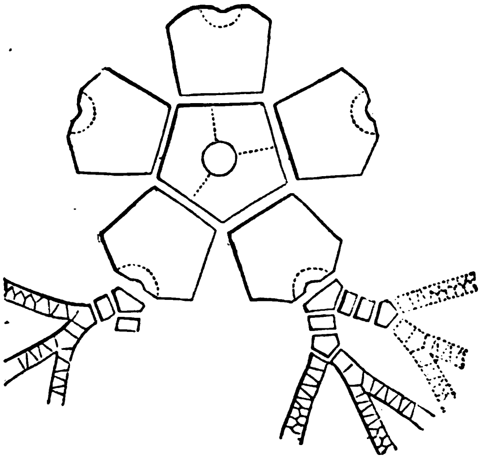
### GENUS PLATYCRINUS, Miller, 1821.*

(Nat. Hist. Crinoidea.)

### PLATYCRINUS HEMISPHÆRICUS, M. and W.

Pl. 20, fig. 2 *a*, *b*.

*Platycrinus hemisphæricus*, MEEK and WORTHEN, 1865. Proceed. Acad. Nat. Sci., Philad., p. 162.



*Platycrinus hemisphæricus.*
Diagram showing structure out to the second divisions of the arms of two rays.

BODY rather above medium size, hemispherical, being rounded below, and about twice as wide as high; base broad; basin-shaped, and forming about one-third the entire height of the cup, with a pentagonal outline, as seen from below; facet for the attachment of the column, between one-third and one-fourth the diameter of the base, and subelliptical in outline. First radial pieces larger than the basal, wider than high, nearly quadrangular, and widening moderately from below upwards; facet for the reception of the second radial, one-third as wide as the summit, and extending down nearly one-fourth the length of the plates; concave and sloping outwards, with a deep notch within. Second radial pieces very small, but filling the cavity in each of the first radials, from which they extend out nearly horizontally; pentagonal in outline, and each supporting on its superior lateral sloping margins the first divisions of the arms, which are comparatively small and bifurcate again on the second piece; beyond this the two outer divisions remain simple, but the two inner divide again on the second piece, making six arms to each ray, or thirty to the entire series. Arms, after the last divisions, long, slender, cylindrical, and composed at first of a simple series of quadrangular pieces, but passing gradually upwards into interlocking triangular pieces, and still farther up forming a double series of small, alternating, cuneiform pieces, supporting closely arranged, long-jointed tentacles. Anal, interradial and vault pieces unknown. Sutures, excepting between the basal pieces, distinctly, but not widely or deeply channeled.

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* For a description of this genus see p. 170, vol. II, Reports Geol. Survey Illinois.

Surface ornamented with rather small, but well defined, prominent nodes. On the base, these nodes are arranged in ten rows, five of which radiate from the facet for the reception of the column, one to each of the corners, while those between each of these form intermediate radiating rows, consisting at first of a single range, but becoming a double or triple range near the margin, when the three sometimes coalesce laterally. On the first radial pieces two rows pass from just beneath the facet for the reception of the second radials to each of the inferior lateral angles, while between these there is, at first, a single node, but farther down two or three rows, consisting of nodes which show a disposition to become elongated, or coalesce laterally, so as to form little transverse ridges. Above, there is also a row extending horizontally to each superior lateral angle, with a few less regularly arranged nodes on the sides below these. A single transversely elongated node sometimes also occurs on the little radials, and one less distinctly defined also sometimes on each of the pieces between this and the next bifurcation.

Breadth of body at summit of first radial pieces, 1.07 inches; height of do., 0.60 inch; breadth of base, 0.67 inch; breadth of second radial pieces at the summit, 0.54 inch; do. of second radials, 0.19 inch.

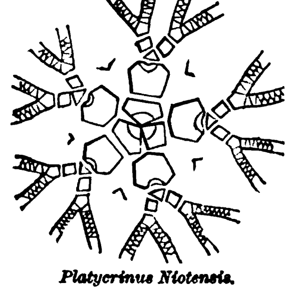
From the description and figures, it will be seen this species is rather closely related to *P. granulatus* of Miller, which it nearly resembles in form and general appearance. It is a larger and more robust species, however, and differs not only in the arrangement of the pustules on the base into distinct radiating rows, but according to Austin's figures and description (Monogr. Recent and Foss. Crinoid., p. 33, pl. iii, fig. 2), in having but six instead of seven arms to each ray as well as in having the arms above the middle composed of a double series of small wedge-shaped pieces, instead of consisting of a single series throughout. From its analogy to *P. granulatus*, of Miller, it will probably be found to possess, like that species, a long subcentral proboscis.

*Locality and position:* Crawfordsville, Indiana. Keokuk division of the Lower Carboniferous series.

## PLATYCRINUS NIOTENSIS, M. and W.

Pl. 20, fig. 8.

*Platycrinus Niotensis*, MEEK and WORTHEN, 1865. Proceed. Acad. Nat. Sci., Philad., p. 162.



*Platycrinus Niotensis.*
Diagram showing structure out to the bifurcations of the arms.

BODY, below the summit of the first radial pieces, cup-shaped, wider than high; sides slightly ventricose above the base. Base, basin-shaped, several times as wide as high, moderately expanding, rather broadly truncated below, its lower margins projecting slightly downwards around the end of the column, and provided with three very small projections, one at the lower extremity of each of its sutures. First radial plates large, higher than wide, widening slightly from below upwards, subquadrangular and subpentagonal, with the superior lateral angles a little truncated by the interradial pieces; each with a concave facet for the reception of the second radials, equaling about half to one-third its breadth above, and excavated nearly one-fourth its length on the outer side, below the upper margin. Second radial pieces trigonal, very small, or scarcely more than filling the facet or excavation in the upper side of the first radials; rounded below, with each superior sloping side supporting secondary radials, on the second of which another bifurcation takes place, making four arms to each ray.

Arms, after the second division described above, simple, and at first composed each of a single series of wedge-shaped plates, but soon passing into a double series of small interlocking pieces, supporting on each side of the arms closely arranged series of long-jointed tentacles.

Column, near the base, compressed and tortuous, being composed of alternately thicker and thiner elliptic pieces, with a very minute central perforation.

Surface somewhat granular; sutures not grooved, nor distinctly apparent; those between the basal pieces indicated by a faint linear ridge.

Height, to summit of first radials, 0.30 inch; breadth, about 0.40. Greater diameter of column at base of body, 0.12 inch; smaller do., 0.09 inch. Breadth of one of the arms, 0.06 inch; length of do., apparently an inch or more.

In its general appearance, this species is not unlike *P. saræ*, of Hall (Iowa Report, p. 673, pl. xviii, fig. 4), though it is much smaller, has a proportionally much shorter base, and also differs in having but four instead of six arms to each ray. In one of the arms on the left of our figure, some restorations made in the drawing about its base, make it appear as if entirely simple after the first division on the second radial. It really bifurcates like the others, however, on the second piece above the second radial.

*Locality and position:* Niota, Hancock county, Illinois. Keokuk division of Subcarboniferous Limestone.

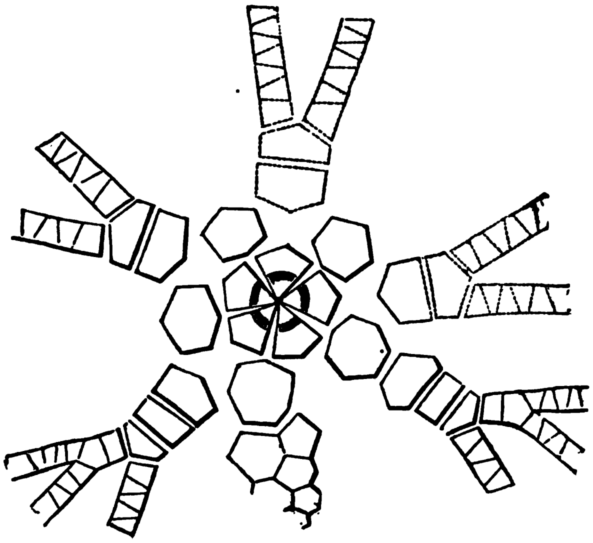
## Genus POTERIOCRINUS, Miller, 1821.[*]

(Nat. Hist. Crinoidea.)

### Poteriocrinus Indianensis, M. and W.

Pl. 20, fig. 4.

*Poteriocrinus Indianensis*, Meek and Worthen, August, 1865. Proceed. Acad. Nat. Sci., Philad., p. 155.



*Poteriocrinus Indianensis.*
Diagram (nat. size) showing structure of body and arms as far as known.

Body rather deeply cup-shaped, or truncato-obconic. Base basin-shaped, comparatively rather broadly truncated below by the facet for the attachment of the column. Basal pieces well developed, pentagonal, and about one-third wider than high. Subradials large, three pentagonal, and two on the anal side hexagonal, there being no defined angle at the middle of the under side of any of these plates. First radial pieces about half as large as the subradials, wider than long, rounded on the outside, and nearly pentagonal, or with one or both of the superior lateral angles slightly truncated, so as to give an obscurely hexagonal or heptagonal outline; all broadly truncated nearly their entire breadth above, and one on the immediate right of the anal series, resting in part directly upon the upper truncated side of one of the subradials, and elevated almost its entire length above the horizon of those of the other rays. In the last mentioned ray, and the one on the immediate left of the anal series, the second piece is quadrangular, and wider than long, while the third is pentagonal and supports the first divisions of the arms on its superior sloping sides. These divisions in the ray on the right are simple, rounded, and each composed of a single series of somewhat wedge-shaped pieces; while the left branch of the one on the left of the anal series, bifurcates again on the second piece, making three arms in this ray, which are constructed like those already described, and continue simple as far as they can be traced. In the only other ray preserved in the specimen, the bifurcation takes place on the second radial, beyond which the arms continue simple.

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[*] For a description of this genus see page 179, vol. II, Reports Geol. Survey, Illinois.

First anal piece nearly as large as one of the first radials, hexagonal, and resting between the upper sloping sides of the subradials, partly under the first radial on the right, while it connects on the left with the second anal, and supports a third on its truncated upper side. Second anal piece rather large, longer than wide, hexagonal, and resting upon the superior truncated side of one of the subradials. Third anal piece smaller than the others, hexagonal, and surmounted by several other hexagonal pieces in direct succession, belonging to the proboscis.

Surface apparently smooth. Facet for the reception of the column rather large, and marked with distinct radiating striæ around the margins.

Length of body, to summit of first radial, about 0.48 inch, excepting in the ray on the immediate left of the anal series, where it is 0.58 inch; breadth, about 0.56 inch. Breadth of facet for the connection of the column, 0.26 inch. Usual diameter of the arms after the bifurcation, 0.12 inch.

*Locality and position:* Crawfordsville, Indiana, in the Keokuk division of the Lower Carboniferous Limestone series.

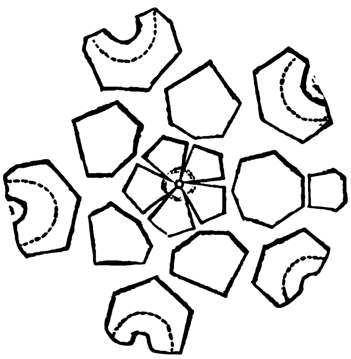
## GENUS CYATHOCRINUS, Miller, 1821.*

(Nat. Hist. Crinoidea.)

### CYATHOCRINUS FARLEYI, M. and W.

Pl. 20, fig. 1 *a*, *b* and 6 *c*.

*Cyathocrinus Farleyi*, MEEK and WORTHEN, July, 1866. Proceed. Acad. Nat. Sci., Philad., p. 252.



*Cyathocrinus Farleyi*. (Nat. size.)
Diagram showing structure of body to first radials, inclusive.

BODY, below the summit of the first radial pieces, rather deep, cup-shaped, or subglobose (oblique in typical specimen), and composed of thick, strong pieces; under side rounded. Base subdiscoidal or depressed basin-shaped, with a pentagonal outline, composed of unequal pentagonal pieces, very narrow at their connection with the column, and widening rapidly to their lateral angles; all curving upwards at their superior outer extremities. Subradial plates three or four times as large as the basal pieces, about as wide as long, convex, and each provided with several irregular wart-like protuberances in the middle; four of them hexagonal, and one on the anal side heptagonal. First radials somewhat larger than the subradial pieces, wider than high, and each having a general pentagonal outline, but the superior lateral angles, which usually extend inwards somewhat between the second radials, are more or less truncated; facet for the reception of the second radials large, or occupying more than three-fourths the breadth of the upper side of each piece, and on the outer side excavated downwards near half the length of the plate, with a distinct outward slope. First anal piece about the size of the largest basal pieces, quadrangular in general outline, but having two other inconspicuous angles above, in consequence of small facets for the reception of three smaller pieces in the next range, probably more properly belonging to the base of the vault, than to the anal series of the body; resting squarely upon the truncated upper side of the heptagonal subradial piece, and connecting on each side with the adjacent first radials, above the horizon of the summits of which it does not project. Surface smooth or finely granular, with the exception of the irregular pustulose protuberances on the middle of each subradial plate. (Arms and column unknown.)

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* For remarks on this genus, see vol. II, p. 175, Reports Geol. Survey Illinois.

Height to summit of first radial pieces, 0.68 inch; breadth, 0.80 inch.

This species will be readily distinguished from all others known to us, by the peculiar little wart-like protuberances on the middle of each subradial piece. These are not incipient radial costæ, nor, properly, nodes, but irregular little pustular prominences, like drops of melted wax adhering to the surface. Some of them are confluent, while others are distinct and irregularly grouped. They rarely extend to the margins of the plates, and are almost entirely confined to the subradials, though there are some obscure indications of one or two small ones on the lower half of one of the first radials.

The specific name of this crinoid was given in honor of Dr. R. D. Farley, of Jerseyville, Illinois, to whom the survey is indebted for some interesting specimens.

*Locality and position:* Keokuk division of the Lower Carboniferous series, at Warsaw, Illinois.

## CYATHOCRINUS? (sp. undetermined.)

Pl. 20, fig. 5 *a*, *b*, *c*.

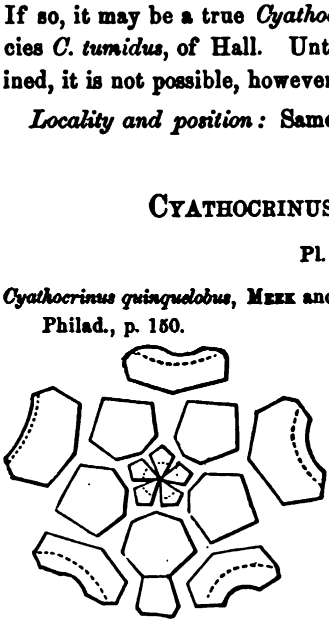
BEING in doubt in regard to the affinities of this crinoid, of which we have only seen the individual specimen figured, we have concluded, for the present, merely to figure it without a specific name, hoping that when the attention of collectors is directed to it, better specimens may be obtained. In the possession of five small basal pieces, five subradials, and five first radials, all united to form the cup, without any anal piece between the first radials, it agrees exactly with the group of Coal Measure species for which we have proposed the name *Erisocrinus*. On a careful examination, however, it will be seen to differ in having the upper lateral extremities of the first radial pieces truncated so as to form a notch, evidently for the reception of interradial or vault pieces, and thus differing from *Erisocrinus*, which has the upper side of all the first radials evenly truncated on the same horizontal plane, entirely across, without any notches for interradials. It is possible that the absence of a first anal piece may be an abnormal character, as we sometimes see in *Steganocrinus pentagonus*, Hall, (sp.) If so, it may be a true *Cyathocrinus*, or might possibly even belong to the species *C. tumidus*, of Hall. Until more nearly complete specimens can be examined, it is not possible, however, to settle these questions satisfactorily.

*Locality and position:* Same as last.

## CYATHOCRINUS QUINQUELOBUS, M. and W.

Pl. 20, fig. 6 *a*, *b*, (not *c*.)

*Cyathocrinus quinquelobus*, MEEK and WORTHEN, August, 1865. Proceed Acad. Nat. Sci., Philad., p. 150.



*Cyathocrinus quinquelobus*. (Nat. size.) Showing structure of body out to first radials, inclusive.

BODY, below the top of the first radial pieces, broad basin-shaped, composed of very thick, strong plates; height, to the summit of the first radial pieces, less than half the width. Base very small, a little concave below, or forming a nearly flat pentagonal disc; basal pieces rather more than half hidden by the column, the portion of each exposed when the column is attached, nearly pentagonal, or subtrigonal, in form. Subradial pieces much larger than the basal, four of them hexagonal, and one on the anal side heptagonal; each with a strongly prominent, bicarinate protuberance, extending out horizontally, like the rays of a pentagonal star, upon which protuberances the body rests, when placed on a level surface, with the under side down. First radial pieces, two and a-half to three times as wide as high, pentagonal, and all transversely truncated their entire breadth above, for the reception of the succeeding radials, so as to present a broad, moderately concave, outward-sloping facet above; those of the two antero-lateral rays each nearly twice as long as the others, and provided, near the middle of the upper margin, with two or more angular nodes or prominences. Sutures, between the body-plates, close-fitting, and not very apparent. First anal piece small, quadrangular, wider than high, resting upon the truncated upper side of one of the subradials, between two of the first radial pieces, above which it does not project. Surface, finely and regularly granular. Facet, for the attachment of the column, of moderate size, a little concave, with a rather small, rounded central perforation, and traces of radiating striæ around the margin.

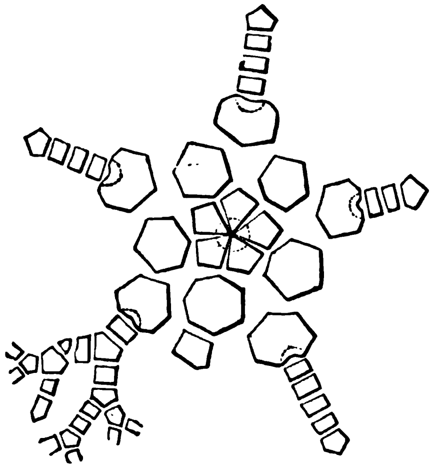
Height, to summit of first radial pieces, 0.55 inch; greater transverse diameter, at summit of first radials, 1.04 inches.

This species is evidently allied to *C. sculptilis* of Hall, from the Burlington Limestone; but it is much more robust, and has more prominent subradial pieces, with the prominences more grooved along the middle. Its base is also more concave, and its first radial pieces, particularly the anterior and posterior lateral, proportionally shorter; while it shows no tendency to develop ridges across from the subradials to the first radials, nor has it any surface striæ.

*Locality and position:* Same as last.

## CYATHOCRINUS ARBOREUS, M. and W.

*Cyathocrinus arboreus*, MEEK and WORTHEN, 1865. Proceed. Acad. Nat. Sci., Philad., p. 160.



*Cyathocrinus arboreus.*
Diagram (nat. size) showing the structure of the body and rays out to the first bifurcation, and of one ray out to some of the divisions of the arms.

BODY rather under medium size, conoid-semioval below the top of the first radial pieces, about as wide as high. Basal pieces well developed, forming a low, basin-shaped cup; all pentagonal, and about as long as wide, the greatest breadth being slightly above the middle. Subradial pieces, three or four times as large as the basal, about as long as wide, usually arcuate, or a little concave on the outside, along the lateral margins—four hexagonal and one heptagonal. First radial pieces of near the same size as the subradials, and presenting a more or less nearly pentagonal outline; facet for the reception of the second radials, nearly equaling one-third the breadth of the first radial pieces, slightly protuberant and sloping outwards. Succeeding radials small, rounded on the outside, and varying from two to five in the different rays—there being but two in one of the posterior rays and five in the other, while the anterior has four, one of the anterior-lateral three, and the other four—all, excepting the last or axillary piece of each ray, being quadrangular. After the first division into two arms on the last radial pieces (at least in one of the anterior lateral rays), another division immediately takes place on the first piece of each principal branch, and of the four branchlets thus formed, the inner two extend directly upwards, and each bifurcates again on the second piece; while the two main lateral branchlets spread out on either side, each giving off above, two or more subordinate divisions, the first of which is seen to bifurcate at least once. The whole of the divisions and subdivisions being thus spread out like the limbs of a tree trained upon a wall. In one of the posterior rays, the bifurcations are as represented in the above diagram; while in the other, there is no bifurcation until on the sixth piece.

All the arms and their divisions are rounded, and the smaller divisions composed of joints that are longer than wide, while no tentacles have been observed connected with any of them.

The first anal piece is quadrangular, a little longer than one of the basal pieces, and rests directly upon the superior truncated side of one of the subradials, while it connects on each side with one of the large first radial pieces, above which it does not project. The sutures are slightly impressed, and the surface nearly smooth, or only obscurely granular.

Height, to summit of first radial pieces, 0.53 inch on the anal side, and 0.55 inch on the other; breadth, at top of first radial pieces, 0.53 inch; breadth of second and succeeding primary radial pieces, 0.15 inch.

We had intended to give a figure of this species on plate 20, but there was not room for it. Before the arrangement of the plate, however, the diagram showing its structure, given at the head of this description, was prepared. As this will assist the student in identifying the species, we have concluded to give it and the description here, along with the other forms from the same position.

*Locality and position:* Keokuk group, of the Lower Carboniferous series, at Crawfordsville, Indiana.

# ECHINOIDEA.

## *PERISCHOECHINIDÆ.*[*]

### GENUS LEPIDESTHES, M. and W.

(λεπις, a scale; εσθης, a garment; in allusion to the imbricating, scale-like arrangement of the plates forming the test, or covering.)

SUBSPHEROIDAL; interambulacral areas narrow, and composed of plates that imbricate from below upwards as well as outwards from the middle; ambulacral areas very wide, composed of numerous small pieces, scarcely differing in form, and all imbricating from above downward; the lower edges of those of each range lapping upon the next series below; ambulacral pores two to each piece, and nearly central. Anal opening, and apical disc, unknown. Jaws well developed. Entire surface ornamented with numerous very small granules of uniform size, probably for the articulation of minute spines, as in *Palæchinus.*

This curious type is evidently related in some respects to *Lepidechinus*, Hall, but differs remarkably, not only in the comparative breadth of its ambulacral and interambulacral areas, but in having the imbrication of the plates of these areas *in exactly the opposite direction.* That is, in *Lepidechinus* the interambulacral plates are said to imbricate from the dorsal side, and the ambulacral from below upwards; while in *Lepidesthes* the interambulacral series imbricate from below upwards (that is the upper edge of each interambulacral plate laps upon the lower edge of the next above), and those of the ambulacral series imbricating from above downwards.[†] A more important difference, however, is that observed in the comparative breadth of the ambulacral and interambulacral areas. In *Lepidechinus*, for instance, the ambulacral areas are "sublinear, little wider than the width of an adjacent single plate of the interambulacral series in the middle of the body;" while in *Lepidesthes* these areas are each about once and a-half the breadth of the whole of each interambulacral field.

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[*] See vol. II, Reports Illinois Geol. Survey, p. 225.

[†] Since these remarks were written, Prof. Hall has described a second species of the genus *Lepidechinus*, (*L. rarispinus*) from the Chemung Sandstone at Meadville, Pa. In this he states that the specimen shows clearly that the imbrication of all the plates are exactly the reverse of what he had supposed in *L. imbricatus*, the type of the genus; but suggests that he may have been mistaken in regard to which was the dorsal and which

The most important difference is to be observed in the structure of the ambulacral areas, which in *Lepidechinus* have only two rows of pieces, and four rows of pores; while in the type under consideration we count *ten* rows of these pieces near the widest part of each field, and twenty rows of pores. It will therefore be seen that our fossil bears almost exactly the same relations to *Melonites*, that Prof. Hall's *Lepidechinus* bears to *Archæocidaris*. That is, it agrees with *Melonites* in the great breadth of its ambulacral fields, and numerous ambulacral pieces and pores, but differs from it in the curious imbricating character of all its plates, just as *Lepidechinus* agrees with *Archæocidaris* in its narrow ambulacra, with large tubercles on its interambulacral plates, and differs in its imbricating plates. Although our fossil presents some other differences from *Melonites* (such as the greater thinness of its plates, and the non-sulcated character of its ambulacral fields, as well as in having the middle two rows of its ambulacral plates not differing in form or size from those on each side), we can but think that if *Lepidechinus* is to be ranged, as has been proposed by Prof. Hall, as a subgenus under *Palæchinus*, that *Lepidesthes* should, upon the same grounds, stand as a subgenus under *Melonites*. We can not believe, however, that so marked a peculiarity as this imbricating character of the plates, seen in these fossils, is of mere subgeneric value. On the contrary, we suspect it will be found to be of even more than generic importance.

We are indebted to Mr. O. W. Corey, of Crawfordsville, Indiana, for the use of the only example of this type we have seen, and to him we have dedicated the species on which the genus is founded.

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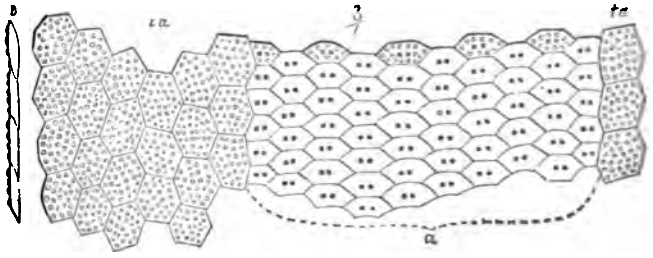
the ventral side in *L. imbricatus*. This is highly probable, and if so, his genus would not differ from ours in the *direction* of the imbrication of the plates, but the other differences are amply sufficient to separate the two types generically.

To facilitate comparisons of this type with *Melonites* and *Oligoporus*, we give the following diagrams: (A) illustrating the arrangement of the ambulacral and interambulacral pieces, in *Lepidesthes;* and (B and C) illustrating the structure of the ambulacra in *Melonites* and *Oligoporus:*

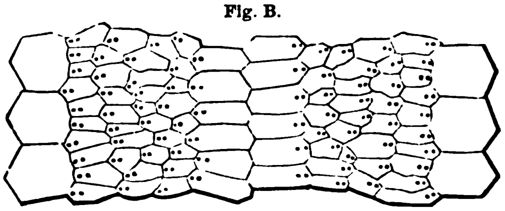
Fig. A.



*Lepidesthes Coreyi.*

Diagram (enlarged 3 diameters) showing the number and arrangement of the ambulacral pieces (*a*) near the middle of the body, with the two pores penetrating the middle of each piece, and, in a few of those above, the granules covering the whole surface of all the pieces. On the left, the interambulacral pieces (*ia*) are seen, showing their arrangement and the comparative narrow breadth of the interambulacral areas. By the side of these plates, (*b*) represents a section of them, illustrating their imbricating arrangement. On the right side of the ambulacral series only, the marginal row of interambulacral plates is represented.

Fig. B.

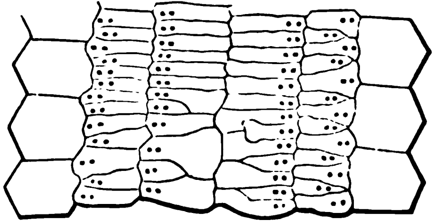


*Melonites multipora.*

Diagram (enlarged 2 diameters) of a part of the ambulacral series near the middle of the area, with some of the marginal row of interambulacral plates on each side.

It is difficult to understand what could have been the object of this peculiar imbricating arrangement of the plates in *Lepidechinus* and *Lepidesthes*, unless it was to impart some degree of mobility to the pieces composing their external crust, so that the animal could at will, or when subjected to accidental pressure, change its form—for instance, from a globose, or depressed globose, to an oval or elliptic outline, or the reverse. At any rate, the specimen from which the foregoing description of *Lepidesthes* was made out, shows that the fossil was susceptible of a considerable compression and distortion, without actually breaking or materially disarranging the plates, which are less than one-third as thick as in *Melonites*. The lapping edges of the plates are all beveled, so as to lie evenly together, and it is evident that the slightest movement of the plates upon each other, even if not perceptible to the eye, would be sufficient to materially change the general form of a body with its crust composed of such a vast number of small pieces.

Fig. C.



*Oligoporus Danæ.*

Diagram showing a portion of the ambulacral series of pieces enlarged two diameters, with a few of the marginal row of interambulacral plates on each side.

## LEPIDESTHES COREYI, M. and W.

(See cut A, opposite page.)

GENERAL form apparently subspheroidal, approaching a broad ovate outline. Interambulacral areas narrow, lanceolate, a little convex, composed, near the middle, of six or seven rows of hexagonal, very slightly convex, plates, the number of rows decreasing towards the extremities, first to five, then to four, and so on to the ends, where each seems to terminate in a single piece. Ambulacral areas nearly or quite flat, rather broad lance-oval in form, and once and a-half to twice as wide as the interambulacral fields; all occupied by numerous small transversely rhombic or subhexagonal pieces, with their lateral angles acute, and deeply interlocking, while the angles above and below are obtuse, or nearly obsolete, so that with their imbricating arrangement, and uniformity of size and shape (the middle rows not differing in these respects from the others), they present somewhat the appearance of the scales on the side of a fish. Of these pieces there are apparently about 10 or 11 rows near the middle of each field, and each has its two small round central pores closely approximated. Surface granules very small, and about 18 to 25 on each of the larger interambulacral pieces, with a proportionally smaller number on all the others, including the ambulacral pieces, which are generally one-third to one-half as large as those of the interambulacral areas.

The only specimen of this interesting type we have seen, is considerably distorted by pressure, and has lost about one-third of the upper side, including the apical disc. Its oral opening is comparatively rather small, round, and has the jaws protruding in a crushed condition. The entire length of the fossil, as near as can be determined in its present distorted condition, was about 1.80 inches, and its breadth about 1.60 inches. The breadth of the interambulacral areas, at the middle, is only 0.37 inch; while that of the ambulacral fields is about 0.60 inch.

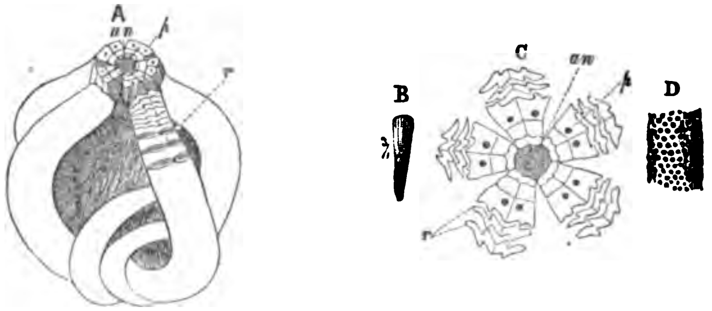
*Locality and position:* Keokuk division of the Subcarboniferous series, at Crawfordsville, Indiana.

# ASTEROIDEA.

## GENUS ONYCHASTER, M. and W.

(ονυξ, a claw; αστηρ, a star; from the resemblance of its folded rays to the claws of a bird, and its general similarity to the *Asteroidea.*)

### ONYCHASTER FLEXILIS, M. and W.



*Onychaster flexilis.*

A. General outline view of the whole fossil, natural size; *an* being the central opening of the disc, and *p*, genital ? pores At *r*, the ossicles forming the skeleton of the dorsal side of one of the rays, are seen, as exposed by the removal of the outer granular integument.

B. One of the longitudinally striated spines from the inner side of the rays, magnified three diameters.

C. The disc, with two pairs of the interlocking pieces (*r*) connecting it with the dorsal side of each ray; (*an*) anal ? opening, (*p*) genital ? pores—all enlarged about two diameters.

D. A portion of the dorsal side of one of the rays, as seen covered with its granular integument, which hides the skeleton structure seen in figure A, at *r*.

THE interesting fossil on which we propose to found this genus and species, seems to differ so widely, in some of its characters, from the true Star-fishes, as well as from the Ophiurians, as to leave doubts whether it can be properly placed in either of these groups as now understood. And yet it certainly differs even more widely from the normal types of the *Crinoidea* and *Echinoidea.* In habit and general appearance, it most nearly resembles the Ophiurians, from which, however, it differs widely in structure. It is composed of a rather small sub-discoid body, and five long, slender, rounded, flexible arms or rays. In nearly all of the specimens yet found, the arms are folded together like the claws of a bird when grasping some small object. A few of them, however, have the arms opened out more or less, so as to show that they were very flexible, or capable of being moved about in all directions. They usually increase slightly in thickness for a short distance from the body, then taper very gradually to their extremities, being about 2.50 inches in length, and 0.22 inch in breadth, at the widest part.

On the dorsal side of the body of the specimen represented by the outline figure A, there is seen a comparatively large circular area or disc, composed of an outer circle of ten rather prominent pieces, united together in five pairs by close-fitting sutures, each piece being pierced by a round ovarian? pore (*p*). Immediately within this circle there is, apparently, another circle of ten smaller pieces, also united in five pairs, but without pores; and within this latter circle there is a third range of five still smaller, non-poriferous pieces, surrounding a central anal? opening (*an*, of fig. A and C);—the whole reminding one of the apical disc of an Echinoid, though differing in structure from this part of the known types of that group. It is also worthy of note, that there is some analogy between this disc and the body of a crinoid, excepting that there is a central opening, and that the first division of the radial series takes place immediately on the inner range of pieces corresponding to the basal pieces of a Crinoid, while all of the third range of pieces are pierced by pores. It is barely possible that in their early stages of growth, these fossils may have been attached like a Crinoid, by a column, connecting with the inner range of disc pieces, so as to close the central opening. Of this, however, we have no evidence, all the specimens yet seen being without any traces of such connecting column.

Immediately outside of the circle of ten pore pieces, mentioned above, each pair of these pieces is succeeded by two or three pairs of differently formed, interlocking, transverse pieces, in direct range, connecting them with the dorsal side of each of the five rays (see let. *r* of cut C). A little farther out the dorsal side of the rays, these transverse pieces are seen to become disconnected by more or less wide spaces (as at *r* of cut A), and gradually pass into pairs of lanceolate pieces, deeply furrowed longitudinally, while between the inner ends of the two pieces of each pair, there appears to be a pore-like opening. These latter disconnected pieces continue all the way out to the extremities of the rays, and, with numerous smaller intervening ossicles, form together, as it were, the skeleton or frame-work of the long flexible rays. It is only, however, when an outer granular integument has been removed, that this skeleton structure can be seen. In some parts of some of our specimens, this outer granular covering remains, and is seen to be composed of numerous small, rounded, rather prominent ossicles, regularly arranged in quicunx, as seen in fig. D, so as to give the surface a chagreen-like roughness. These ossicles were doubtless attached to, and secreted by, a soft dermal envelope, covering the whole surface, while the larger pieces within, formed the frame, as it were, of the whole structure, and probably furnished points of attachment for the muscles that moved the rays.

None of our specimens show clearly the inner side or ambulacral furrows of the rays, nor the under side of the body—consequently we know nothing of the nature or position of the mouth or of the ambulacra. In several instances, however, we have seen the remains of one or more rows of small, short, longitudinally striated spines (fig. B) along the inner side of the arms.

The entire breadth of a mature individual, across between the extremities of the rays on opposite sides, if these rays were straightened out, would be about five to six inches.

*Locality and position:* Crawfordsville, Indiana; Keokuk division of the Lower Carboniferous series.

# MOLLUSCA.

## BRACHIOPODA.

### GENUS PRODUCTUS, Sowerby, 1814.

(Min. Conch., vol. I, p. 153.)

### PRODUCTUS MAGNUS, M. and W.

Pl. 20, fig. 7 *a*, *b*, *c*.

*Productus magnus*, MEEK and WORTHEN, June, 1861. Proceed. Acad. Nat. Sci., Philad., p. 142.

SHELL attaining a large size, subhemispherical, or in outline semioval; hinge-line equaling, or slightly exceeding, the greatest breadth of the valves at any other part; ears nearly rectangular, not arched. Ventral valve moderately gibbous, or forming a more or less nearly regular semicircular curve from the beak to the front, rounding down rather strongly on each side to the ears, which are not abruptly separated from the swell of the umbo; central region with a shallow, narrow, mesial sinus, extending from the front about two-thirds of the way to the beak; umbonal region not very prominent; beak small, incurved, and passing but slightly beyond the hinge-margin; interior unknown. Dorsal valve distinctly concave, but nearly flat over a large portion of the central region, and strongly curving up at the front and lateral margins, usually with a slight mesial ridge corresponding to the sinus of the other valve. Interior with a rugose ridge extending around near the front and lateral margins, so as to present a somewhat geniculated appearance, not seen on the outside; cardinal process stout, apparently rather short, and bifid ?, its base forming a short stout ridge, which soon becomes obsolete near the muscular scars, from between which a narrow ridge extends forward two-thirds to three-fourths the length of the valve, becoming sharply elevated and thin at the end; scars of adductor muscles elongated, parallel and rugose; reniform scars rather broad, and somewhat roughened by a few irregular wart-like prominences; spaces between the reniform scars and the mesial ridge flat, and without any traces of the subconical prominences seen in *P. giganteus;* posterior lateral regions irregularly pitted or punctured.

Surface of both valves ornamented by numerous rather coarse, often waved or flexuous, striæ, or small obscure costæ, that increase by intercalation and division, all sometimes becoming nearly obsolete on and near the ears; fine concentric striæ are also seen on all parts of the surface, and over the visceral region, very obscure traces of small concentric wrinkles likewise occur. On the ventral valve, bases of small spines are seen irregularly scattered, being most numerous, largest, and most closely arranged, on the ears and along the hinge-margin. No spines occur on the dorsal valve, but little pits seem to occupy their places.

Length of largest specimen seen, 3 inches; breadth, 3.30 inches; convexity, about 1.60 inches. Number of surface striæ in 0.20 inch, five or six.

This fine species is probably most nearly allied to some varieties of *Productus giganteus*, Martin (sp.), but presents well marked internal and external differences from all the forms usually regarded as varieties of that shell. Its most marked external differences consist in the distinct flatness of the visceral region of its dorsal valve, and its more angular ears, which are also never arched. The interior of its dorsal valve also differs in the possession of a rugose ridge near the front and lateral margins, and particularly in showing no traces whatever of the mammiform protuberances in the spaces partly encircled by the reniform scars. These scars, in our shell, are likewise different in shape from those of *P. giganteus*, and the ridge between them longer. Our own comparisons, it is true, have been made only with figures and descriptions of *P. giganteus*, but Mr. Thomas Davidson, of London, to whom specimens of our shell were sent, writes that he thinks it must be distinct from that species.

Prof. Swallow has described a shell, from the Coal Measures of Missouri, under the name *Productus Americanus* (Trans. St. Louis Acad. Sci., vol. II, p. 91, 1862), that seems, from his description, and tracings made from his drawings of typical specimens, nearly allied to our species, and may possibly be the same. If so, the name *Americanus* will have to be ranged as a synonym under our name *magnus*, which was *published* some six or eight months in advance, though Prof. Swallow's paper was *read* first.

*Locality and position:* Monroe county, Illinois, and St. Genivieve county, Missouri; in the Keokuk division of the Lower Carboniferous limestone series.

## GENUS SPIRIFER, Sowerby, 1815.

(Min. Conch., II, p. 42.)

### SPIRIFER PROPINQUUS, Hall.

Pl. 19, fig. 8 *a*, *b*, *c*.

*Spirifer propinquus*, Hall, 1858. Geological Report of Iowa, Vol. I, part II, p. 647.

SHELL attaining a moderately large size, subtrigonal, very convex; breadth between twice and three times the length; hinge line the widest part; lateral extremities acutely angular. Ventral valve depressed pyramidal, the highest part being at the beak, which is not in the slightest degree arched; anterior and lateral slopes abrupt; mesial sinus rather narrow and deep, well defined, rounded and without plications; area large, perfectly flat, and somewhat inclined forward, with distinctly angular margins; foramen large, three-fourths as wide at the hinge line as its height. Surface with about twenty-four simple, rounded plications on each side of the mesial sinus, the lateral ones of which intersect the angular margin of the area, without reaching the beak; lines of growth rather obscure.

Length (of the ventral valve) about 1.30 inches; breadth, 3.70 inches; height of area (which is also the convexity of the valve), 1.25 inches; breadth of foramen, 0.80 inch.

This species evidently belongs to the same group as the punctate European form usually referred to *S. cuspidatus*, Sowerby, as it presents the same general outline, and is distinctly punctate; and we have also ascertained, by working out the matrix filling the foramen, that it likewise has the same deep-seated transverse plate between the dental laminæ, as well as the internal tube of that type.

It differs specifically, however, from *S. cuspidatus*, in being much wider in proportion to its length, and in having its lateral extremities acutely angular and its ventral valve and area much lower, while it also has more numerous costæ.

In 1865–6, one of the writers* discovered that several of our American shells allied to, or in part identical with, *Spirifer cuspidatus*, Sowerby, as well as a specimen sent by Mr. Thomas Davidson, of Brighton, England, from Melicent, Ireland, with that name attached, all showed clearly a punctate structure, and that at least all of the American examples of these shells, the interior of which could be seen, also possessed a peculiar internal tube, attached to a transverse plate passing across between the dental laminæ, upon which latter character, Prof. Winchell had previously proposed to found a genus *Syringothyris*, the types of which, however, he thought were not punctate.†

As Dr. Carpenter, the distinguished Microscopist of London, had long back, after repeated careful examinations, failed to detect any traces of punctures in British examples of *S. cuspidatus*, and was quite confident that it must be impunctate, the question (which we had not the foreign specimens at hand to solve) was asked by one of us, in publishing the results of the examinations mentioned above, whether there might not be two British types confounded under the one name *S. cuspidatus*—that is, one rare one with a punctate structure and the internal tube of *Syringothyris*, and another, more common, without either.

At a later date, Dr. Carpenter re-examined many British examples of these shells, and at first thought his original conclusion correct, that is, that *none of them* are punctate, and that we were probably in error in regard to this character existing in the shells examined here.‡ Subsequently, however, after examining chippings sent by us from the American forms, as well as from the Irish specimen alluded to above, he confirmed the conclusion that these shells are really punctate. He then examined many British specimens of the form generally referred to *S. cuspidatus*, and arrived at the conclusion that there is amongst them two distinct types—one punctate, and possessing the internal tube, and another without either.¶

Still more recently, Prof. King, of Queens College, Galway, has investigated these shells, and maintains that there is but *the one* British type, *S. cuspidatus*, and that, when well preserved, it is *always* punctate and provided with the internal tube, which characters, he thinks, were only accidentally absent in a part of the specimens examined by Dr. Carpenter. Believing this punctate structure a character of sufficient importance to separate these shells generically from those forms like *S. striatus*, that have not a punctate structure, he proposes to retain the name *Syringothyris*, for the *S. cuspidatus* group, and *Spirifer* for the impunctate group.[*] Mr. Davidson also writes that he thinks there can be no doubt in regard to some of the British shells which he considers the true *S. cuspidatus* having the internal characters on which *Syringothyris* was proposed.

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* See paper by F. B. Meek, in Proceedings Acad. Nat. Sci., Philad., Dec., 1865, p. 275, published Feb., 1866. For further remarks on this subject, see a communication, by Prof. Hall, published in Proceed. Am. Philosoph. Society, for May, 1866.

† They have since been found to be punctate, however; see Am. Jour. Sci., May, 1867, p. 467.

‡ Ann. Mag. Nat. Hist., Aug., 1866, p. 144.

¶ Ibid., July, 1867.

Admitting the accuracy of these examinations, and that these punctate shells should be separated generically, or subgenerically, from those without this character, the question arises whether or not the generally accepted rules of nomenclature will permit us to retain the name *Syringothyris?* Although there may be different opinions on this point, it certainly seems to us, that as *S. cuspidatus* was the only species described by Sowerby, in first proposing the genus *Spirifer*, and the first species to which he applied that name, it should be regarded as the type of the genus *Spirifer*. If so, then *Syringothyris* would apparently be an exact synonym of *Spirifer*, and Kœnig's name *Trigonotreta*, should be retained for the impunctate species like *S. striatus*.

If *Syringothyris*, however, is to be retained, the name of Prof. Hall's species we have here described, would become *Syringothyris propinqua*, as it has exactly the characters of the type for which that name was proposed.

Our figures and description of the species under consideration were made out from the original typical specimen of *S. propinquus*, which has not hitherto been figured.

*Locality and position:* Near Warsaw, Illinois; in the Keokuk division of the Lower Carboniferous series.

# LAMELLIBRANCHIATA.

## GENUS AVICULOPECTEN, McCoy, 1851.

(Ann. Mag. Nat. Hist., vol, VII, p. 171.)

### AVICULOPECTEN INDIANENSIS, M. and W.

Pl. 19, fig. 6 *a*, *b*.

*Aviculopecten Indianensis*, MEEK and WORTHEN, 1866. Proceed. Chi. Acad. Sci., vol. I, p. 14.

SHELL (left valve) rather compressed, not oblique; lateral margins rounding from near the middle into the regularly rounded ventral border; umbonal slopes converging to the beak at an angle of about ninety degrees; cardinal line less than the breadth of the shell. Anterior ear compressed so as to be rather distinct from the umbonal slope, subtrigonal in form, and a little rounded in outline so as to cause its margin to intersect the hinge at an obtuse angle, separated from the adjacent posterior margin by a rather wide, shallow, subangular sinus. Beak rather compressed. Posterior ear apparently of about the same size as the other, but more angular in consequence of the broadly rounded, shallow sinuosity of its margin being continued to the hinge line. Surface ornamented with depressed, irregular, nearly flat or somewhat rounded, radiating costæ, from forty to forty-five of which may be counted around the free border of the body part of the valve, and about eight or ten on each ear—those on the anterior ear being more distinct than on the other. Costæ sometimes bifurcating, but generally increasing by the intercalation of smaller ones between, which are rarely continued quite to the beak; all crossed by concentric, very thin raised lines, regularly disposed at intervals, about equaling the wider ribs on the body of the valve, but more closely arranged on the ears.

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[*] Ann. Mag. Nat. Hist., July, 1868.

Transverse and longitudinal diameter each about 1.85 inches; convexity of left valve, 0.20 inch.

The specimen of this species from which the figure on plate 19 was drawn, is not in a very good state of preservation, and the engraving is unfortunately far from being satisfactory, but with the aid of the description, it is hoped the student may be able to identify the species. Figure 6*a* is a cast from the matrix, represented by figure 6*b*. In the latter, more of the posterior wing is seen than in the former, but it is probably not entirely complete in either. The anterior ear of figure 6*a* has the marks of the costæ wrongly represented parallel, instead of converging to the beak; on the same ear, seen on the right side of the mould, represented by figure 6*b*, there should be some ten or twelve costæ, instead of only two or three. As the mould is of the outside only, it of course does not show the cardinal plate.

Since the figures and description of this species were prepared, we have seen a specimen (also a left valve) from the same locality and position, agreeing with it quite closely in form and general appearance, but having the concentric markings more crowded, and the radiating costæ proportionally smaller and less strongly defined; while the latter are only very faintly indicated on the ears. If this is a variety of the same species, which we think very probable, it would show the species to vary considerably in the details of its surface markings.

*Locality and position:* Crawfordsville, Indiana; from the Keokuk division of the Lower Carboniferous limestone series.

## GENUS ANTHRACOPTERA, Salter, 1862.

(Mem. Geol. Surv. Gr. Brit.; Country around Wigan, p. 87.)

### ANTHRACOPTERA? FRAGILIS, M. and W.

Pl. 19, fig. 4.

*Anthracoptera? fragilis*, MEEK and WORTHEN, 1866. Proceedings Chi. Acad. Sci., p. 18.

SHELL thin, aviculoid, very oblique, moderately convex, the right valve being more compressed than the other. Hinge margin equaling about half the length of the shell, bordered by a linear ridge, and ranging at an angle of thirty-five degrees above the oblique umbonal axis, terminating posteriorly in a compressed angular wing, considerably shorter than the posterior part of the valves below, from which it is separated by a rounded marginal sinus. Anterior side short, narrowly rounded, and projecting beyond the beaks as a kind of lobe or pouch, separated from the umbonal gibbosity by a broad, undefined, very oblique depression, extending from the beaks to the anterior ventral margin. Posterior side compressed and obliquely produced; its margin rather narrowly rounded in outline, and sloping obliquely forward and upward, above; ventral border oblique, rather distinctly sinuous about midway between the middle and the anterior extremity. Beaks very oblique, moderately convex, little elevated above the hinge line, and placed about one-third the length of the hinge margin and anterior lobe, behind the anterior extremity; umbonal slopes convex, but not very prominent. Surface with fine, obscure, concentric striæ, and more distinct, somewhat imbricating marks of growth.

Length of a medium sized specimen, measuring obliquely from the anterior extremity to the posterior margin below the wing, 1.38 inches; height from the most prominent part of the base to the summit at the posterior extremity of the wing, 0.79 inch; convexity of left valve, 0.20 inch.

This species has much the aspect of some of the more aviculoid forms of *Bakevellia*, but it is a thinner shell, and seems to have its cardinal margin more compressed, and apparently without the area seen in that genus. As near as can be determined, without a knowledge of its hinge and interior, it seems to be congeneric with the species represented by Mr. Salter's figure illustrating the characters of his genus *Anthracoptera;* though not, as we think, with his *A. carbonaria* (Jour. Geol. Soc., XIX, p. 79*), which has exactly the general external appearance of a true *Myalina*, and seems to be closely allied to some of our western Coal Measure species of that genus, always associated with marine types in the western states. As seen imbedded in the matrix, with the wing hidden or broken away, it has the appearance of a *Modiola.*

*Locality and position:* Near Warsaw, Illinois; Keokuk division of the Lower Carboniferous series.

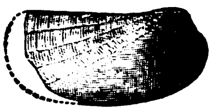
## GENUS PLEUROPHORUS, King, 1844.

(Ann. Mag. N. H., vol. XIV, p. 313.)

### PLEUROPHORUS COSTATIFORMIS, M. and W.

Annexed cut, and fig. 8? of pl. 19.

*Pleurophorus costatiformis*, MEEK and WORTHEN, Dec., 1865. Proceed. Acad. Nat. Sci., Philad., p. 247.



*Pleurophorus costatiformis.*

SHELL elongate, suboval, moderately convex, slightly arcuate; the dorsal and ventral margins rather long, and more or less nearly parallel, the former being a little concave in outline, and the latter convex; extremities narrowly rounded. Beaks small, depressed, or rising little above the hinge-line, very oblique, somewhat compressed, incurved, and placed very near the anterior end; lunule apparently small and deep. Surface ornamented by concentric striæ of growth, and a few larger, obscure, concentric wrinkles, crossed on the postero-dorsal region by five distinct, equidistant and radiating ridges, extending obliquely from the beak to the posterior margin, the lower one being the largest, and forming the umbonal ridge, while the upper one runs parallel to the cardinal margin, and forms the edge of the long corslet, or escutchen.

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* It is worthy of note, that the form figured by Mr. Salter, under the name *Anthr. carbonaria*, is widely different, in outline, from Prof. Dawson's figure of his *Naiadites carbonaria*, supposed to be the same (see Acad. Geol., 2d ed., p. 204, fig. 42), though this may possibly have resulted from distortion.

Length, about 1.10 inches; height, 0.46 inch; convexity, near 0.43 inch.

It is remarkable that this species is so very similar to *P. costatus*, Brown (sp.), of the European Permian System, that, if some of the specimens were found in rocks of that age, few would ever suspect them to belong to any other species. Owing to the fact, however, that the *Lamellibranchiata* are generally more restricted in their geological range than some types of the *Brachiopoda*, we think it very improbable that a species of this class should have survived all the changes of physical conditions that occurred between the deposition of the Lower Carboniferous and Permian rocks.

The specimen figured on plate 19 was originally supposed to be a variety of this species, and by some oversight it was figured instead of the typical form. We are now nearly satisfied, however, that it is a distinct species, and, in addition to this, the figure alluded to, owing to defects in the engraving, fails to illustrate very clearly the characters of the specimen from which it was drawn. In order, therefore, to prevent confusion, and to give a better idea of the shell described, we add here a wood cut of the typical specimen from which the description was originally drawn up.

*Locality and position:* Keokuk division of the Lower Carboniferous series, at Warsaw, Illinois.

## Genus LITHOPHAGA, Lamarck, 1812.

### Lithophaga lingualis, Phillips? (sp.)

Pl. 19, fig. 1 and 2.

*Modiola lingualis*, Phillips, 1836. Geology Yorks., vol. II, p. 209, pl. v, fig. 21.
*Lithophaga? lingualis*, Meek and Worthen, 1865. Proceed. Acad. Nat. Sci., Philad., p. 245.

Shell elongated, very thin, rather compressed, widest posteriorly, where it is strongly compressed and somewhat narrowly rounded in outline; anterior end more convex, and very narrowly rounded or subangular in outline; greatest convexity from the umbonal region along nearest the dorsal side, back toward the middle; beaks extremely oblique, very nearly terminal and somewhat obtuse; dorsal margin generally a little concave in outline, from the beaks back to the central region. Surface marked by fine lines and irregular furrows of growth, often passing into little concentric wrinkles or undulations in passing over the most convex part of the valves.

Length of largest specimen, about 3.30 inches; height about 0.95 inch; convexity, about 0.50 inch.

We are by no means satisfied that this is the species described by Phillips, but prefer to refer it provisionally to that species, rather because we have been unable to find any very reliable differences, than from any great confidence in its exact identity. Some of our specimens are much larger than that figured by Phillips, but in all other known characters they are certainly very similar, so far as can be determined from his figure and very brief description.

As the hinge and interior of these shells are entirely unknown, we have no means of determining, with certainty, their generic relations. The shell (or, at any rate, all that remains of it in our specimens) is exceedingly thin, though we have been unable to see any indications of a prismatic structure in it. In one specimen, from Crawfordsville, Indiana, believed to be the same species, numerous, very minute cracks can be seen radiating with great regularity to the posterior, posterior-dorsal and basal margins, which they intersect nearly at right angles—those above curving upward, and those below downward. These have the regularity and direction of surface markings, but seem rather due to some peculiarity of the structure of the shell, than to surface sculpturing.

*Locality and position*: Warsaw, Illinois, and Crawfordsville, Indiana, in the Keokuk division of the Lower Carboniferous series.

## GENUS SEDGWICKIA, McCoy, 1844.

(Synop. Carb. Foss., Ireland, p. 61.)

### SEDGWICKIA (SANGUINOLITES?) SUBARCUATA, M. and W.

Pl. 19, fig. 8 *b* (not 8 *a*).

*Sedgwickia* (*Sanguinolites*) *subarcuata*, MEEK and WORTHEN, 1865. Proceedings Acad. Nat. Sci., Philad., p. 251.

SHELL elongate, suboval, somewhat arcuate, rather convex in the central anterior and umbonal regions; anterior side sloping, with a slightly convex outline from the beaks forward, and rather narrowly rounded at the extremity; posterior side narrow and compressed above and behind the umbonal ridge, and obliquely truncated at the extremity; dorsal outline horizontal and concave behind the beaks; ventral margin forming a long, gentle, convex curve, nearly parallel to the dorsal margin, curving up gradually toward the front, and very abruptly at the posterior basal extremity. Beaks moderately prominent, and placed about one-third the entire length of the shell from the anterior extremity; umbonal ridge prominently rounded from the beaks to near the posterior basal extremity. Surface of cast without visible concentric ridges or other markings.

Length, 2.20 inches; height, 0.95 inch; convexity, 0.72 inch.

We are by no means sure that this shell belongs to the genus *Sedgwickia*, as properly restricted to such forms as *S. attenuata* and *S. corrugata*, of McCoy, since it is more elongated, and wants the concentric ridges usually seen on these shells. In general outline, it approaches some species of *Cercomya*, Agassiz, such for instance as *C. striata*, from the Upper Jura, but its posterior seems to have been very nearly smooth. As we only know it from casts, nothing can be determined in regard to its hinge, nor have we any means of ascertaining the nature of its muscular and pallial impressions. Possibly we should call it *Allorisma subarcuata*, though its rather prominent umbonal ridge, compressed posterior dorsal region, apparently smooth surface, and convex anterior slope, without a depression in front of the beaks, give it a kind of *Lyonsia*-like aspect, not generally seen in the typical species of that genus.

Owing to a slight defect in the shading, the engraving of this species is made to appear as if there was a broad, shallow compression or concavity in the anterior ventral portion of the valves. This, however, is not the case, that portion of the valves being evenly convex.

*Locality and position:* Upper beds of the Keokuk division of the Lower Carboniferous series.

## GENUS ALLORISMA, King, 1844.

(Ann. Mag. Nat. Hist., xiv, p. 316.)

### ALLORISMA (CHÆNOMYA?) HYBRIDA, M. and W.

Pl. 19, fig. 3 *a*, (not 3 *b*.)

*Chænomya? hybrida*, MEEK and WORTHEN, Dec., 1865. Proceedings Acad. Nat. Sci., Philad., p. 250.

SHELL longitudinally oblong, moderately convex, somewhat arcuate; dorsal margin concave in outline, ventral border longer than the dorsal, and forming a broad, gentle curve, nearly parallel to the dorsal outline, excepting a very faint sinuosity in advance of the middle; posterior side a little compressed near the extremity, but rather distinctly gaping, truncated or somewhat rounded in outline; anterior margin sloping forward from the beaks above, and apparently narrowly rounded below. Beaks moderately prominent, somewhat compressed, and placed less than one-fourth the length of the valves from the anterior extremity; umbonal slopes not prominent; flanks evenly convex in the central region, and a little contracted anteriorly, so as to form a very faint undefined depression from the beaks to the base. Surface (of a cast) showing small, obscure, concentric ridges, which are most distinct and regular along the posterior umbonal slopes, where they are abruptly deflected upward at an obtuse angle; anteriorly they are smaller, more closely arranged, and deflected obliquely forward and upward.

Length, 1.90 inches; height to cardinal margin, 0.90 inch; to summit of beaks, 1 inch; convexity, 0.68 inch.

This form can only be referred provisionally to the genus *Allorisma*, since we know nothing of its hinge and muscular and pallial impressions, or finer surface characters. It has the form of the typical species of that group, excepting that its posterior extremity is rather more widely gaping, somewhat as in *Chænomya*, but not to the same extent. Its most peculiar surface character is the abrupt deflection of its obscure concentric ridges, which give it much the appearance of a *Goniomya*. Indeed, if found among Cretaceous or Jurassic fossils, we would not hesitate to call it *Goniomya hybrida*. As in some species of *Goniomya*, the ridges run parallel to the base along the middle of the valves, between the points where they are deflected, and do not form a V shaped angle. These peculiarities of the ridges are not well represented in the figure. In front of the beaks they are small, closely arranged, and, instead of curving as represented, they are nearly straight, parallel, and pass at first obliquely backward and downward, then backward parallel to the base, to the region of the posterior umbonal slopes, where they become larger, and are rather abruptly deflected upward and a little backward.

*Locality and position:* Keokuk division of the Lower Carboniferous series, at Nauvoo, Illinois.

# ARTICULATE FOSSILS OF THE COAL MEASURES.

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## CRUSTACEA.

### ENTOMOSTRACA.

### *GNATHOSTOMATA.*

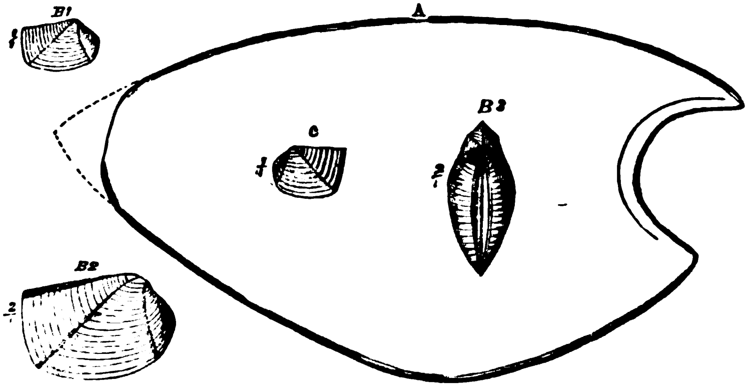
### PHYLLOPODA.

### Genus CERATIOCARIS, McCoy, 1849.

(Ann. and Mag. Nat. H., 2d s. IV, p. 412.)

### Ceratiocaris? sinuatus, M. and W.

*Ceratiocaris? sinuatus*, M. and W., 1868. Am. Jour. Sci., vol. xlvi, p. 22.



*Leaia tricarinata.*

Fig. B 1. Right valve, nat. size.

Fig. B 2. Another example of same, enlarged two diameters.

Fig. B 3. Dorsal view of another specimen of same, enlarged two diameters, showing the lanceolate false area, bounded by a linear ridge on each side.

Fig. C. Another specimen of a left valve, natural size, differing somewhat in form, and possibly a distinct species.

*Ceratiocaris? sinuatus.*

Fig. A. An outline, natural size, apparently of the inner side of the right carapace-valve. The anterior extremity may possibly have been as angular as the dotted outline indicates, as the specimen is a little defective there. The inner line, near the margin of the deep posterior sinus, indicates the breadth of the beveled inner edge.

Of this large *Ceratiocaris?* we have seen but one tolerably good specimen of one of the carapace-valves. It is very thin, with apparently a rather shelly texture, and is crushed and flattened by pressure, though its outline is clearly and neatly defined. Its general form is somewhat rhombic-subovate; while its truncated posterior end is so deeply sinuous as to give the extremities above and below the sinus a rather acutely angular appearance, particularly that above. Along the dorsal margin, it forms a much depressed arch from end to end. The anterior end is rather obtuse in the specimen, but apparently, in part at least, from accidental distortion. The widest (deepest) part is slightly behind the middle, where the base is rather prominent. From near this point, the inferior margin ascends with a nearly straight outline, very obliquely, both forward and backward.

At first we were rather inclined to think the apparent smoothness of the surface of this fossil (there being no traces of surface striæ) a serious objection to the conclusion that it belongs to the genus *Ceratiocaris*, but, on farther examination, we are led to think this due to the fact that it is the inner and not the outer surface of the valve that is exposed.

As the genus *Ceratiocaris*, however, has not, we believe, been hitherto found so high in the geological series as the Carboniferous, this may be found to belong to a distinct but allied genus.

*Locality and position :* Lower part of Coal Measures of Waupecan creek, Grundy county, Illinois.

## GENUS LEAIA, Jones, 1862.

(Appendix to Monogr. Fossil Estheriæ.)

### LEAIA TRICARINATA, M. and W.

Wood cut fig. B 1, B 2, B 3 (and C ?), opposite page.

CARAPACE-VALVES moderately convex, longitudinally oblong, the length and height being generally as about 40 to 27, but variable in different individuals; anterior outline rounded; basal margin more or less convex in outline; truncated posterior margin very nearly straight, and often a little oblique, so as to meet the dorsal margin at rather less than a right angle; dorsal margin straight, and in each valve abruptly inflected at right angles to the plane of the valves, so as to form a distinct, lanceolate corselet, margined on each side by a sharply defined, linear carina; lateral carinæ or ridges linear, well defined, and diverging from the beaks at an angle of about 60°, the anterior one, which is the longer, straight, and extending to the posterior basal margin, and the anterior or shorter one a little curved and passing from the beaks to the anterior basal border; surface marked by about 12 to 16 minute, very slender, regularly disposed, concentric, hair-like striæ, running parallel to the basal and posterior and anterior margins.

Length of a rather large individual, 0.40 inch; height, 0.27 inch; convexity, about 0.19 inch.

Our specimens of this little fossil are numerous, and some of them show its form and surface markings very distinctly, though the substance of the shell itself, which was evidently extremely thin, and probably corneous, is always wanting. The moulds of the exterior, and casts of the interior, show that the carinæ, and the exceedingly delicate concentric lines raised on the outer surface, were impressed or concave within. In compressed or flattened specimens, such as are usually found in shales, the third carina, along the dorsal margin, and the abrupt inflection of the latter, are scarcely apparent, but in the better preserved specimens, such as are found in concretions, these charactsrs are readily seen.

On comparing our specimens with Mr. Lea's figures of the *Leaia Leidyi*, from Pennsylvania, they are seen to differ, not only in being usually about twice as large, but in having the posterior margin more obliquely truncate, the base more convex in outline, the radiating carinæ more sharply defined, and the valves proportionally shorter; while the Pennsylvania species seems to be without the third carina along the dorsal margin. In order, however, to have our specimens compared directly with Mr. Lea's type, we sent some of them to him for comparison, but he was unfortunately unable to find his typical specimen, at that time, in the Museum of the Academy of Sciences, though he writes that he can scarcely doubt that they are specifically distinct.

Our species, however, agrees more nearly with a form described and figured by Prof. T. R. Jones, from the Lower Carboniferous rocks of Scotland, as a variety of *L. Leidyi*, under the name *L. Leidyi*, var *Salteriana*, another from the Upper Coal Measures of England, under the name *L. Leidyi*, var *Williamsoniana*. They differ, however, not only in some details of form, but in being much larger, while Mr. Jones neither illustrates in his figures, nor mentions in his descriptions, the third carina along the cardinal margin, nor the abrupt inflection of the latter, seen in our specimens.

It is worthy of note, however, that some of our specimens, such as that represented by fig. *c*, found flattened in shale, show no traces of the third carina, and agree almost exactly, in outline, with a form figured by Dr. Dawson, in the 2d edition of his Acadian Geology, p. 256, from the Lower Carboniferous of Nova Scotia, and identified by Prof. T. Rupert Jones with *L. Leidyi*.

It is barely possible that the compressed condition of the specimens of *E. Leidyi*, found elsewhere, may have prevented the third carina and inflection of the dorsal margin from being seen, and that our specimens may therefore not be specifically distinct; but, with such means of comparison as we now possess, we do not feel warranted in identifying our specimen with *L. Leidyi* proper, or with either of the named varieties.

*Locality and position:* The specimens represented by the cuts B, were found by Capt. Freeman in LaSalle county, Illinois, in the lower part of the true Coal Measures; and that represented by cut C, is from a high position in the Upper Coal Measures of St. Clair county. Mr. Bradley also found it in the upper part of the lower true Coal Measures, in Vermilion county.

# *MEROSTOMATA.*

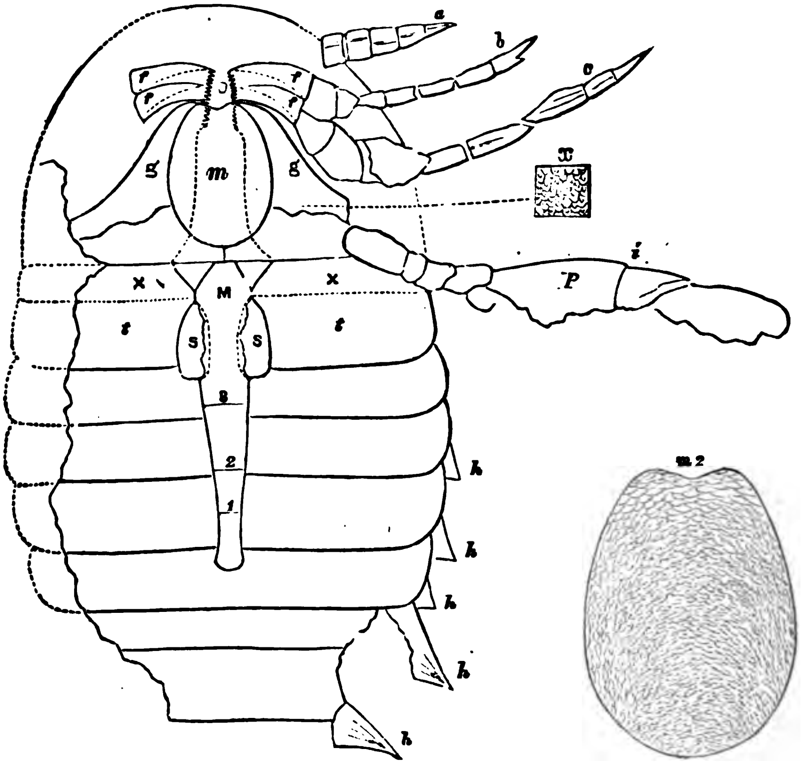
## EURYPTERIDA.

## GENUS EURYPTERUS, De Kay, 1825.

(Anh. Lyc. Nat. Hist. N. Y., 1, p. 375.)

### EURYPTERUS (ANTHRACONECTES) MAZONENSIS, M. and W.

*Eurypterus* (*Anthraconectes*) *Mazonensis*, MEEK and WORTHEN, 1868. Am. Jour. Sci., Vol. XLVI, page 21.



*Eurypterus* (*Anthraconectes*) *Mazonensis*—(Nat. size.)

*a, b, c.* Crushed and broken legs as they appear in the specimen, the divisions not being all natural articulations.

*h, h, h, h, h.* Impressions of angular ends of the dorsal half of body segments.

*m.* Hypostoma in place; *m 2*, the same enlarged to show the scale-like sculpturing.

*P.* One of the paddles or swimming feet in a broken condition. Its division at *i* seems to be a natural articulation.

g, g. Basal joints of same; *x*, enlarged surface-sculpturing of the latter.

*M.* Mesial appendage of the operculum; 1, 2, 3, its apparent articulations; *s, s*, two little accessory pieces; x x, *t, t,* lateral alæ of operculum.

*O.* Position of mouth.

THE only specimen of this interesting fossil we have seen, consists merely of an impression of the ventral side, seen in an iron-stone concretion. It shows portions of the organs of the head, the operculum, and eight of the body segments, in a more or less complete condition. Four of the legs are seen on the right side, crushed and distorted to such an extent as to prevent the possibility of distinguishing, in all cases, between accidental breaks and natural articulations. Consequently it was thought best to represent them in the above cut as nearly as they *appear* in the specimen as possible, although some of the apparent divisions are doubtless not natural. It is evident, however, that the three smaller of these organs (*a*, *b*, *c*) are not provided with little lateral spines at any of the articulations, as is usually the case in *Eurypterus;* while they appear to each terminate in a single pointed dactylus, as in *Pterygtous.* The larger swimming foot (*P*) appears to be much as in *Eurypterus*, though it is too imperfectly preserved in the specimen to show the details of its structure. The division at (*i*), however, is apparently a natural articulation. The basal joints (g, g) of these swimming organs seem to present a general oval-subtrigonal outline, and extend forward as far as the anterior end of the post-oral plate (*m*). The form of this latter organ is very clearly defined, being an elliptic-oval, with the anterior end rather distinctly emarginate. Its length is 0.76 inch, and its breadth, 0.55 inch.

Some faint traces of the outline of the anterior and lateral margins of the head indicate a length of about 1.36 inches, and a breadth of about 2.10 inches. The post-oral plate is about 0.76 inch in length and 0.55 inch in breadth, the widest part being slightly behind the middle. From near or a little behind the middle, it rounds off rather rapidly to the rounded posterior end, and tapers a little to the anterior extremity, which is rounded on each side, and distinctly emarginate in the middle.

The body measures 2.42 inches in length, from the posterior margin of the head, back to the eighth segment, inclusive (that is, counting two thoracic segments as being hidden by the operculum), though it may be properly slightly more, as one of the segments seems to have been a little slipped under the next one in advance of it, when the impression was made. The widest part of the body measures 2.35 inches. On the ventral side, the thoracic segments seem to be all rounded at their lateral extremities, but impressions in the matrix show that the dorsal half of some of them, as well as of at least some of the abdominal segments, terminate laterally in acutely angular projections (*h*, *h*, *h*, *h*, *h*) extending out more or less beyond the rounded ends of those on the ventral side. As these increase in prominence posteriorly, it is probable that they become much produced, as in *Stylonurus*, toward the posterior portion of the abdomen, which is unfortunately not preserved in our specimen, as it extended beyond the limits of the enveloping concretion.

The operculum or thoracic flap has its lateral alæ, as in the typical species of *Eurypterus*, looking as if composed of two of the body segments anchylosed, the anterior one (+) being not more than half the length of the other (*t*), which is of the same size as the thoracic segments.* Its mesial appendage (*M*), however, is greatly elongated, as it extends back to near the middle of the sixth segment, or to a length of 1.60 inches, gradually narrowing toward the extremity, which is slightly expanded, truncated, or somewhat rounded, and *not bipartite.* It shows rather distinctly two articulations (1 and 2), and some appearances of another (at 3), but we are not sure the latter is a natural division. At its basal or anterior end there are also two little supplementary spatulate pieces (*s*, *s*), apparently not homologous with any part of the operculum of *Eurypterus*, as hitherto illustrated, so far as we have yet seen. These are about 0.41 inch in length, and 0.15 inch in breadth, with nearly parallel sides and pointed anterior extremities, while their posterior ends are transversely truncated, with rounded lateral angles. They evidently overlapped the mesial appendage of the operculum along their inner edges, instead of passing under it, as we had at first supposed; otherwise only about half of their breadth would have left its imprint on the matrix. That they really are separate and distinct pieces from the other parts of the operculum, is not only shown by their distinctly defined outline, but by the different arrangement of the little scale-like surface markings ornamenting their surface, from that of those on the alæ.

All the portions of the under side of the fossil that have left their impression in the matrix, were covered with fine, sub-imbricating, scale-like markings. These seem to have been largest on the anterior end of the post-oral plate, as may be seen by the enlarged figure (*m* 2). On the basal joints of the large swimming feet, they are larger and smaller mixed together, as may be seen by the enlarged figure (*x*). On the under side of the body segments, they are generally very minute, excepting near their lateral extremities, where they are somewhat larger.

From some of the characters mentioned above, it will be seen that this fossil differs from the typical forms of *Eurypterus*, particularly in the great length and simple extremity of the mesial appendage of its operculum, as well as in the possession of the two little spatulate supplementary pieces (*ss*). Hence we very strongly suspect that other characters will be found, when better specimens can be studied, showing it to belong to a distinct subgenus, if not indeed to an entirely distinct genus from *Eurypterus* proper, in which case we have proposed for it the name *Anthraconectes.*

It is worthy of note, however, that Jordan and von Meyer have described, from the Coal Measures of Saarbruck (Palæontographica, vol. 4, p. 8, 1856), under the name *Adelophthalmus*, a curious Eurypteroid fossil, that possibly may

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* These alæ in *E. remipes*, and some other Silurian species, resemble body segments so closely, that they were actually mistaken, by Prof. Hall, for "anchylosed first and second segments of the body." (Palæont. N. Y., vol 3, p. 398, fig. $3^1$ and $_2$), and not suspected by him to be homologous with any part of the operculum itself, of the genus *Limulus*. This error was pointed out and corrected by Mr. Woodward, in his Memoir on the genus *Pterygotus*, published by the Palæontographical Society, pp. 40 and 41, 1866.

be generically identical with ours. As their specimen only shows the *upper* side, however, and ours the *under*, we have no means of making a satisfactory comparison. Yet the fact that their type shows similar angular projections at the extremities of the thoracic segments, and an abrupt contraction in the breadth of the abdomen, apparently also indicates that our fossil may possibly be generically identical. If so, our type will, of course, as we have elsewhere stated, have to take the name *Adelophthalmus Mazonensis*.

*Locality and position:* Mazon creek, Grundy county, in the lower part of the true Coal Measures. The specimen described was discovered by Mr. John Collins, of Morris, Grundy county, Illinois.

## ZIPHOSURA.

### GENUS EUPROOPS, Meek, 1867.

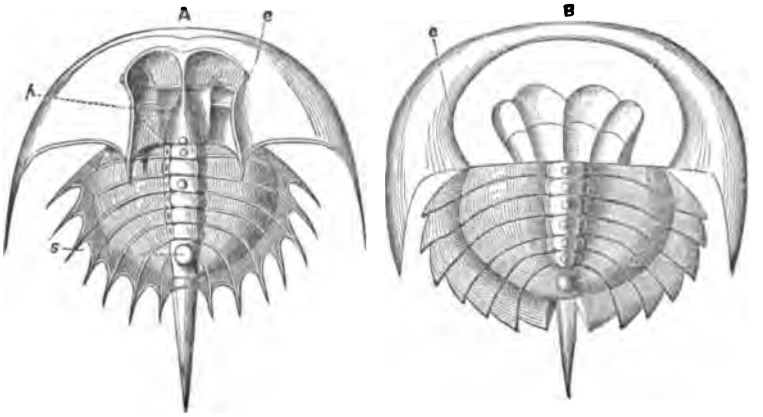
(Am. Jour. Sci., 2d ser., vol. XLIII, p. 394.)

### EUPROOPS DANÆ, M. and W.

*Bellinurus Danæ*, **MEEK** and **WORTHEN**, March, 1865. Proceed. Acad. Philad.; Geol. Reports Illinois, vol. II, p. 395, 1866.

*Prestwichia Danæ*, **MEEK**, 1867. Am. Jour. Sci., 2d ser., vol. XLIII, p. 257.

*Euproops Danæ*, **MEEK**, 1867. Ib., p. 394.



A. *Euproops Danæ* (nat. size)—*e*, eyes; *p*, three pairs of little pits along the sides of the mesial lobe of the cephalothorax, corresponding to those seen along the middle lobe of the body; *s*, a node that may have supported a spine.

B. *Prestwichia rotundatus*, (for comparison); *e* showing the position of the eyes, which are seen to be at the lateral extremities of a large transversely oval area; while the included space has the ridges and depressions also very different from those of *Euproops*.

In first studying the type for which the above name was proposed, we were at once struck with its general agreement with the genus *Bellinurus*, as that group was usually understood, excepting that its body segments are anchylosed, instead of being free (as was said to be the case in *Bellinurus*), and certain other apparent differences in the position of the eyes and the arrangement of the ridges of the head, which we at that time suspected might be, in part at least, due to the accidentally crushed condition of the foreign specimens, of which no good figures, and but brief descriptions, had then been published. Hence we referred our species provisionally to the genus *Bellinurus*, at the same time, however, calling attention to the apparent differences mentioned above.

Soon after the issue of the second volume of the Illinois Reports, in 1866, in which our fossil was again described and figured, under the name *Bellinurus*, one of us observed that Mr. Henry Woodward had, in a paper read before the Geological Society of London, during the same year, proposed to divide the genus *Bellinurus*, as then understood, into two distinct genera, one of them (the original genus *Bellinurus*) being characterized by having the abdominal segments free, as in the Trilobites, and the other, for which he proposed the name *Prestwichia*, by having them anchylosed, as in *Limulus*. No illustrations, however, were published at that time by Mr. Woodward, nor did he state which species he regarded as the type of the new genus *Prestwichia*, nor which as the type of the original genus *Bellinurus*. From the fact, however, that our fossil certainly has the segments of the body anchylosed, it was naturally inferred here, that it belonged to the new genus *Prestwichia*, to which it was consequently removed.

At a later date (February, 1867), Mr. Woodward published excellent figures, in the Quart. Jour. Geol. Soc., London, vol. XXIII, pl. 1, of the typical forms of both *Prestwichia* and *Bellinurus*. From these it became evident that the peculiarities of the ridges of the head of the form on which he founded the genus *Prestwichia*, and which we had supposed probably due to some accident, really exist. Consequently, our type was regarded as being generically distinct, and the name *Euproops* was proposed by one of us for it. Mr. Woodward, however, has since expressed the opinion that these differences are probably of scarcely more than specific value. (See Geol. Mag., Jan., 1868, vol. V, p. 2.) Without professing to have made an especial study of the fossil *Crustacea*, on which Mr. Woodward is well known to be an eminently reliable authority, we would state that we can scarcely doubt that a comparison of *specimens* would lead him to the conclusion that the American form is at least subgenerically, if not generically, distinct from *Prestwichia*.

At any rate, in order to afford the means for comparison, we have prepared the annexed cuts of the type of the genus *Prestwichia*, taken from Mr. Woodward's figure in the Geological Magazine, and of the Illinois type, drawn from much better specimens than that first figured by us. It is proper that we should state here, however, that we have not seen any *one* specimen as complete in all respects, as represented in our figure here given, though our specimens, taken together, show very clearly all of the characters represented. From these figures it will be seen that the Illinois form differs from the type of the genus *Prestwichia*, not only in the position of the eyes, and the form and size of the glabella, or central area of the cephalothorax, but in the entire arrangement of the ridges and included areas of the same.

*Locality and position :* Same as last.

# TETRADECAPODA.

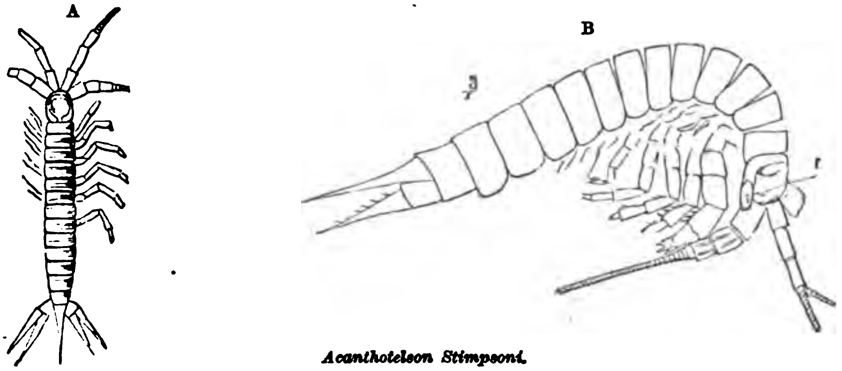
## *ISOPODA.*

### ? Genus ACANTHOTELSON, M. and W., 1860.

(Proceed. Acad. Nat. Sci., Philad., p. 45.)

### Acanthotelson Stimpsoni, M. and W.

*Acanthotelson Stimpsoni*, Meek and Worthen, 1860. Ibid. p. 47.



*Acanthotelson Stimpsoni.*

A. A dorsal view of a small specimen, a little enlarged, showing the telson and stylets spread out horizontally. It also shows the legs extended out on both sides, and *all* directed forward, so as to indicate that the animal could stand and walk upon them, and that it did not habitually lie on one side, as we usually see in the typical *Amphipoda.*

B. A view of another specimen, enlarged three diameters. In this instance the animal was flattened sidewise in the concretion, like all of those first found. It is split in such a way as to show only one of the stylets and a part of the legs. On the side of the head, it shows an oval, apparently protuberant body (ı), that may be the eye. It is connected with a ridge extending back to the posterior part of the head.

It is rather remarkable, that all the specimens of this genus first found lie flattened in the concretions, *on one side or the other*, as shown in our figures published in the second volume, as well as in the above cut B. The fact that so many individuals had been obtained in this condition, and that none were found enveloped as if standing with their thoracic legs spread out on each side for walking, led us to think the former probably their natural posture, and that, like the typical *Amphipoda*, they might not have had the power of standing and walking upon their legs. Several of the specimens recently obtained, however, are enveloped in such a manner, that, in splitting open the concretions in the direction of the plane of their greater (horizontal) diameter, we have exposed a dorsal view of the fossil, with the thoracic legs extended out on each side (see fig. A), so as to show that the animal could stand and walk upon them, and that this was probably its natural posture.

These specimens also clearly show, as may be seen by the above cut (A), as well as by the cut (A), on the opposite page, of another species, that it was only in consequence of the merely accidental lateral compression to which they had been subjected, that the telson and stylets were turned edge upward in most of the specimens, as illustrated by our figures in the second volume.

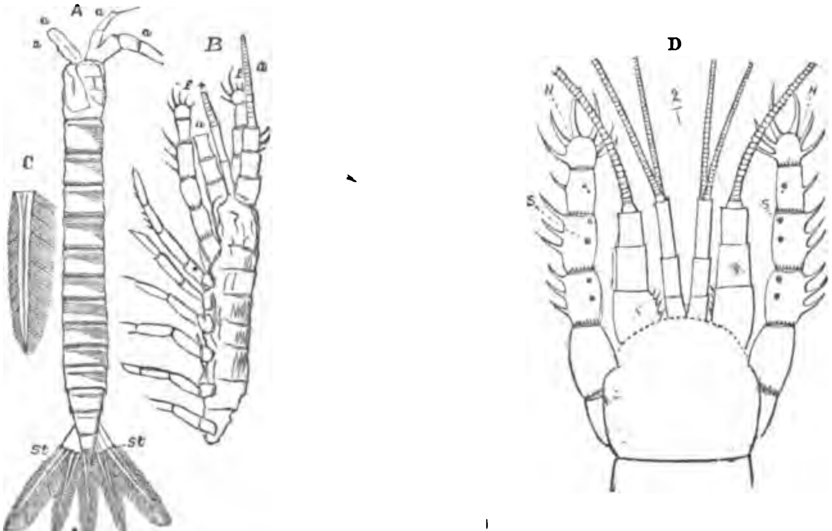
One of the specimens of the following species (represented by the enlarged figures B and D) exhibits the anterior legs more distinctly than any of those formerly seen. From this, these legs are seen to be somewhat stouter than the others and not chelate, but armed by strong spines along the outer and under sides, while they terminate, apparently, in a short division, provided with six stout, palmately-spreading, curved and pointed, finger-like spines. Some of these spines may have been articulated; but in the specimen they certainly *seem* to be rigid and inarticulate. It is probable, however, that these legs were prehensile, by the folding back of the last division upon the others. In some respects, they resemble the corresponding legs of *Gampsonyx*, from which, however, this type differs generically in not having its legs bifid, as well as in the nature of its telson and stylets.

From all the specimens of this genus now known, it is evident that, in the nature of its antennæ, as well as in the forward direction of *all* its thoracic legs, and to some extent even in the nature of its caudal appendages, it differs from the *Tetradecapoda*, and approaches some of the lower types of the Macrural *Decapoda*. In the possession of seven distinct thoracic segments, without a carapax, however, as well as in the form of all its thoracic and abdominal segments, it agrees with the *Tetradecapoda*, particularly with the *Isopoda*, which have but one pair of the abdominal appendages styliform, instead of three, as in the *Amphipoda*. One specimen of *A. Stimpsoni* (represented by fig. B, page 549) also appears to show the eyes (marked I in the cut) to be *sessile*, though remarkably prominent. If they are sessile, this would be conclusive evidence that it must be a *Tetradecapod*. Until other examples, showing more clearly the nature of its eyes and some other parts, can be examined, we leave it provisionally, where we first placed it with doubt, in the Isopod group of the *Tetradecapoda*.

*Locality and position:* Same as last.

## ACANTHOTELSON EVENI, M. and W.

*Acanthotelson Eveni*, MEEK and WORTHEN, 1868. Am. Jour. Sci., 2d ser., vol. XLVI, p. 28.



***Acanthotelson Eveni.***

**A.** Dorsal view (natural size) showing the body, stylets (*st*, *st*) and telson (*t*).

**B.** View of another specimen, crushed obliquely sidewise, showing the legs, antennæ (*a*, *a* and x), etc. This specimen shows the anterior legs (*f*, *f*) more clearly than any other seen.

**C.** One of the stylets of the specimen (A) enlarged, to show more distinctly its marginal setæ.

**D.** An enlarged diagram, made out from the specimen represented by fig. B, and others, showing the anterior legs (H, H) and the antennæ, as seen from above, supposing the whole to be flattened. The dots (*s*, *s*) in the anterior legs represent punctures in the matrix, left by spines on the lower side.

THIS species differs from *A. Stimpsoni* in being larger and more robust, while its body is proportionally longer and more slender. All its legs, and its inner antennæ, also have proportionally longer and more slender joints. In the specimen from which the above cut (A) was made, it will be observed that the stylets *seem* not to be connected with the penultimate segments, but with the one next in advance of it. Although at one time we believed this to be the case, we now rather incline to the opinion that this is a deceptive appearance, produced by an accidental displacement of the parts after the death of the animal.

The name of this species was given in honor of Mr. Joseph Even, of Morris, who discovered the specimens.

*Locality and position:* Same as last.

# DECAPODA.

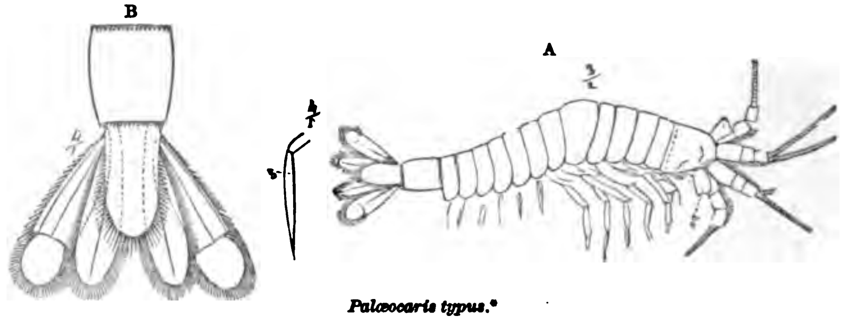
## *MACRURA.*

## GENUS PALÆOCARIS, M. and W., 1865.

(Proceed. Acad. Nat. Sci., Philad., p. 48.)

### PALÆOCARIS TYPUS, M. and W.

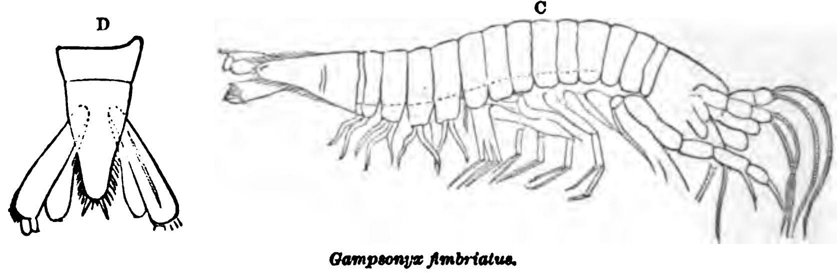
*Palæocaris typus*, MEEK and WORTHEN, Ibid. 49.



*Palæocaris typus.**

A. Cut representing a specimen, enlarged 8 diameters, a little obliquely flattened, so as to make the body segments appear of greater vertical depth than natural. The caudal flaps on one side are partly restored, and what appear to be basal scales (*b s*) connected with the outer antennæ on both sides, are added here from another specimen of the same species; *s* represents one of the abdominal swimming feet, enlarged 4 diameters.

B. Represents the telson and caudal lamellæ, with one of the abdominal segments, all enlarged 4 diameters.



*Gampsonyx fimbriatus.*

C. Cut of this species, magnified about 2⅓ diameters beyond the natural size, for comparison with *Palæocaris*. It is reduced from Jordan and von Meyer's greatly enlarged figure.

D. Telson and caudal lamellæ, with one abdominal segment of same; after Jordan and von Meyer.

IN first studying the genus *Palæocaris*, from the imperfect specimens then known, we were left in doubt whether or not the specimen showing the caudal appendages and jointed body, represented by our figure 5 *a*, plate 32 of the second volume of these Reports, really belonged to the same fossil as the one showing the legs, appendages of the head, and (imperfectly) the segments of the body, represented by fig. 5 of the same plate, though we believed them to belong, as then stated, to the same species. The specimens more recently obtained, however, show that these parts really do belong to the same fossil. Hence it would seem to present something of a combination of Decapod (Macruran) and Tetradecapod characters. That is, it possesses the caudal appendages, anteriorly-directed thoracic legs, the antennæ,* and general aspect of a Macruran, with the distinct head, divided thorax (without a carapace) and seven pairs of thoracic legs, of a Tetradecapod. We have not been able to see its eyes, but, from its other Decapod characters, and its analogy to *Gampsonyx*, which is said by von Meyer to have pedunculated, or at any rate movable, eyes, we are strongly inlined to believe that our fossil will be found to agree with *Gampsonyx* in this character also.

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* In the second volume of the Illinois Reports (Pl. 32, fig. 7), we figured, under the name *Acanthotelson inequalis*, a specimen we then believed to be a second species of that genus. The specimens we have since seen show it to be only a laterally compressed example of *Palæocaris typus*, with the caudal appendages accidentally broken away.

It therefore becomes a matter of interest to determine to which of the subclasses, *Decapoda* or *Tetradecapoda*, it really belongs. That it belongs rather near *Gampsonyx*, though not to the same subordinate section (*Schizopoda*), there can be little doubt. Hence these two forms apparently fall naturally into the same family. Professors Jordan and von Meyer seem to have regarded *Gampsonyx* as a Tetradecapod, connected with the *Amphipoda*, but also possessing Macrural Decapod affinities. Prof Dana, however, regards it as a low type of Macrura, belonging to the section *Schizopoda*. He and Dr. Stimpson, to whom we sent sketches of our better specimens of *Palæocaris*, concur in the opinion, judging from all its characters yet known, that it is a low embryonic type of the Macrura, in which the carapace is not developed.

Generically, it is separated from *Gampsonyx*, figures of which (cuts C and D) we have added for comparison, not only in the nature of its caudal appendages, but in the more important character of having its thoracic legs simple, and not bifid, as in the *Schizopoda*.

*Locality and position:* Same as last.

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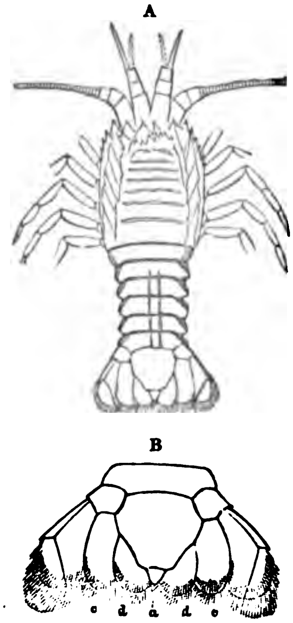
* Some of the specimens appear also to show basal scales to the outer antennæ, as represented by cut A, at *b s*.

## GENUS ANTHRAPALÆMON, Salter, 1861.

(Quart. Jour. Geol. Soc., Lond., XVII, p. 529.)

### ANTHRAPALÆMON GRACILIS, M. and W.

*Anthrapalæmon gracilis*, MEEK and WORTHEN, 1865. Proceed. Acad. Nat. Sci., Philad., p. 50; see also vol. II, Reports Ill. Geol. Survey, p. 407, pl. 32, fig. 4 *a*, *b*, *c*, 1866.



*Anthrapalæmon gracilis.*

A. Dorsal view, somewhat enlarged, with the upper surface of the carapace removed.*

B. Caudal parts of same, including one of the abdominal segments in advance of the telson, all considerably enlarged.

THE only specimen of this species seen by us, at the time the plates for the second volume were prepared, is very imperfect in several respects, and, as we have since had an opportunity to examine several much better examples, which, taken together, give a very clear idea of its general appearance, it has been thought desirable to prepare a cut showing all of its characters, yet known. It is true we have not seen any one specimen so nearly entire as represented in the annexed cut A; but all the parts represented in the cut have been seen in the different specimens taken together, in the same relative positions. The thorax is represented as seen in specimens split horizontally, so as to remove the dorsal side of the carapace, and show the segmentary structure of the parts within. The outline of the carapace, however, is clearly impressed in the matrix, and serrated on each side, anteriorly, as seen in the cut. We have seen no specimen showing the outside of the dorsal portion of the carapace, but a single example in the collection is broken in such a manner as to show that it *has* a rostrum, as in the typical species of the genus, excepting that it seems not to be serrated.

From the specimens before us, it appears that what we had at first thought might possibly be the peduncles of the eyes, in the specimen first figured by us, are probably the peduncles of the inner antennæ, or at least their first joints.

The specimen originally figured by us, has the caudal parts so crushed and distorted as to prevent the possibility of making out their details, but we restored them in outline from Mr. Salter's figure of the typical species, stating at the same time that we had not seen them in ours. The specimens since obtained, however, show all these parts very clearly, and that they differ materially from Mr. Salter's illustration; so much so indeed, that if it were not for

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* We are not sure that the cut represents the ultimate segments of any of the legs entire; and it is not intended to represent the whole length of the antennæ.

the fact that his specimen evidently had these parts very imperfectly preserved, we would almost be inclined to believe that our fossil might belong to a distinct but allied genus. As his specimen had the extremities of the telson and the lateral lamellæ broken away, and is otherwise imperfect, we may reasonably infer that it will be found, when better specimens can be examined, to possess essentially a similar structure of these parts. On comparing our enlarged wood cut, B, of the caudal parts and the penultimate segment of the body, with the corresponding parts of Mr. Salter's typical species, as restored by him, the differences to which we allude will be readily seen. For instance, in our species there are two accessory lamellæ (*d d*) and a small terminal palette (*a*) not represented by Mr. Salter. The lateral fins or lamellæ also show transverse or oblique divisions, not represented in his figure. It is easy to understand, however, how such characters might not be apparent to even so careful an observer as Mr. Salter, in a specimen in the condition of that studied by him.

The specimens now before us, show very clearly that the legs of this crustacean are not divided as in the *Schizopoda*, though there can be no doubt in regard to its being a Macruran. It is not, however, as might be inferred from the name, nearly allied to the recent genus *Palæmon*, as has been, we believe, stated by Mr. Salter, since the genus was originally named by him.

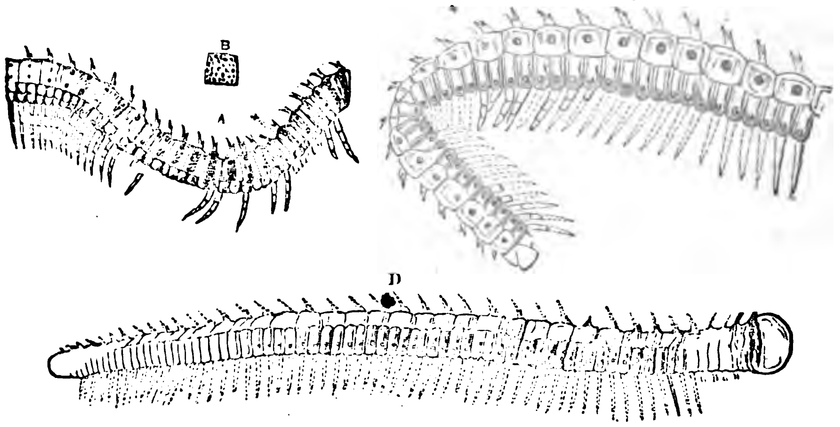
# MYRIAPODA.

## GENUS EUPHOBERIA, M. and W., 1868.

(Am. Jour. Sci., 2d ser., vol. XLV, p. 26.)

### EUPHOBERIA ARMIGERA, M. and W.

*Euphoberia armigera*, **Meek** and **Worthen**, 1865. Ibid.



*Euphoberia armigera.*

A. Cut of a part of a small individual, obliquely flattened, and split open in such a way as to obscure the smaller ventral half of the segments. The pits (x) seen in the larger dorsal parts of the segments, are holes in the matrix left by dorsal spines.

B. Enlargements of the surface pitting seen in the dorsal scutes.

C. Cut of a larger specimen, in which the two kinds of segments are more distinctly seen, owing to its being flattened in the matrix in a somewhat different manner. It also appears to show the posterior end of the fossil. The dark spots seen in the dorsal scutes are pits left in the matrix by spines.

D. This cut represents apparently an entire specimen, with the head; it is so imperfectly preserved, however, as not to show the details distinctly. Although the dorsal spines are all represented in dotted lines, some of them are distinctly visible in the specimen. Only one of the legs, however, is well preserved in this specimen.

IMPERFECT specimens of the fossil for which the above generic and specific names were proposed, have been known to us, amongst the collections from Mazon creek, for some time past, but, owing to their fragmentary condition, we were for some time puzzled in regard to their true nature. We could scarcely doubt that they belonged to an articulate animal of some kind, and were inclined to regard it as a Myriapod; but as all our examinations of the specimens then known had failed to satisfy us that what looked like legs, projecting out into the matrix, were really not inarticulate spines,* we were left in some doubt, whether or not it might be an impression of the vertebral column of some little vertebrate animal. After every examination, we always laid the specimens aside in doubt, hoping that better examples might be found that would afford the means of determining their true nature. In the meantime, however, we showed them to several of our most eminent Naturalists, none of whom could give us any satisfactory suggestions in regard to the affinities of the animal.

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* At that time we had seen no specimens showing the legs distinctly, though several of them showed some of the dorsal spines very clearly.

Several of the specimens since obtained (discovered by Mr. Even), at the same locality, are more complete, in some respects, than any of those first found, and from these we have satisfied ourselves that this fossil is not a vertebral column, but an articulated animal, and, from all its characters, we can scarcely doubt that it is a Myriapod.* One of these more nearly complete specimens seems to be nearly entire, and shows a semicircular head, as wide as any part of the long slender body. It is not in a condition to show the eyes, nor are any remains of mandibles, antennæ or other appendages preserved. The entire length of this specimen (fig. D) is 3.90 inches, and its breadth about 0.20 inch. It tapers very little from the anterior to the posterior end, which seems to terminate rather abruptly. In the whole length, as many as about seventy-five or seventy-six segments may be counted. But it is worthy of note that there are only *half this number on the dorsal side*, where each one corresponds to two below. As seen in a side view (the specimens being flattened by pressure), the downward curved ends of the dorsal scutes, or dorsal half of the segments, are apparently more or less rounded, while each of these pieces supports three or four small, pointed spines, curved a little backward, and arranged so as to form as many rows along the back of the animal. Some of these spines are seen to give off a small, very short branch, generally on the anterior side.

On the under side of the body there are, as already explained, two segments to each of the dorsal scutes, and these segments, of course, are scarcely half the size of those above, though each bears a pair of small, slender-jointed legs, about 0.25 inch in length, in the specimen nearly 4 inches long, of the typical species *E. armigera.* So far as can be made out, these legs show at least five gradually tapering joints.

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* In the second volume of the Illinois Reports (p. 409, pl. 32, fig. 1 *a*, *b*), we described and illustrated from the Morris locality, under the name *Anthracerpes*, another very different fossil, which we were at that time somewhat inclined to regard as a Myriapod, from the fact that, in some of the fragments, we thought we could see faint impressions of what might have been very small, weak legs. Prof. Scudder has, however, since expressed the opinion, in a paper published in the fifth volume of the Geological Magazine, p. 216, on the Fossil Insects of North America, that this is more probably a worm; and, as some other specimens we have since seen show no traces of legs, we agree with him in this opinion that it is most probably a worm.

In speaking of this fossil as "this so-called Myriapod," we have no doubt but it was unintentionally that Prof Scudder omitted to explain that we did not positively refer it to that group, but merely spoke of it as "a fossil, the relations of which have not been very clearly determined," but which we were "rather inclined to view as a Myriapod." In describing the genus under the heading *Myriapoda*, we also prefixed a query, in order farther to express our doubts, and to prevent any one who might not read over our remarks from supposing we had decided it to be a *Myriapod.*

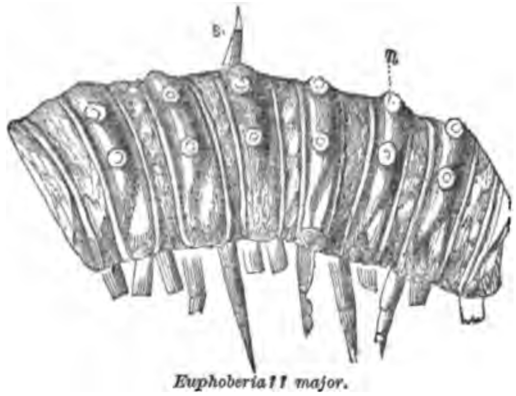
In some of the specimens, the smaller lower segments show some appearances of openings like spiracles. These, however, appear to exist in *each one* of the lower parts of each segment. A still larger and more rounded opening, or pit, is also seen just below each of the latter, and may be the point of attachment of the legs. In the specimen represented by fig. A, as well as in that from which fig. C was drawn, it will be observed there are also round pits or perforations (x x) in the larger dorsal scutes. These are cavities left in the matrix by spines. In order to understand this, however, it is necessary to bear in mind that the specimens are altogether mere *impressions* left in the matrix. On comparing figures A and C, it will be observed that there are more of these pits in the former than in the latter, and other differences that might seem to indicate that they belong to very different species. These differences, however, we are rather inclined to believe due to the different manner in which the specimens have been crushed, and the fact that the specimen represented by figure C is pressed nearly flat, while the other retained more of its natural convexity, and likewise shows more of the dorsal side and less of the smaller ventral segments.

Under a magnifier, the surface of all the specimens shows a minutely granular appearance, represented by the little enlargement figure B. As these granules are seen on the surface of moulds or impressions left in the matrix, they indicate the presence of a minutely pitted marking on the fossil itself.

*Locality and position:* Lower part of true Coal Measures, Mazon creek, Grundy county, Illinois.

## EUPHOBERIA ? ? MAJOR, M. and W.

*Euphoberia major* M. and W., 1868. Am. Jour. Sci., vol. XLV, p. 26.



*Euphoberia?? major.*

Cut of a fragment consisting of six of the dorsal scutes, and parts of two others, with one of the dorsal spines (s) broken and lying in the matrix. The nodes (n) are evidently spine bases. Some of the legs are seen below.

THIS name was proposed by us for a much larger fossil than the typical species of the genus, though we unfortunately yet know it only from mere fragments, one of the best of which is represented by the annexed cut. If as long in proportion as the other species, it probably attained a length of 12 to 15 inches, and must have presented a formidable appearance. The node-like prominences, marked *n* in the figure, are evidently the bases of spines that have been broken away. One of these, however, is seen lying in the matrix at the point marked *s*. Another specimen (not figured) shows a direct view of the dorsal side, compressed flat. In this, traces of two rows of these node-like prominences are seen along the middle, while a row of spines can be seen projecting out into the matrix on each side.

This latter specimen so nearly resembles a fossil figured by Mr. Salter in the Quarterly Journal of the Geological Society of London, vol. XIX, p. 84, fig. 8, from the Staffordshire Coal Measures, under the name *Eurypterus? (Arthropleura) ferox*, that we can scarcely entertain a doubt that they are congeneric. Indeed, if it were not for the fact that the species *ferox* has its spines each provided with three, instead of two, prongs, we would even suspect that our specimens might possibly belong to the same species. Mr. Salter thought his specimen probably a part of the central lobe of a trilobate *Eurypterus*, or some allied genus, an opinion he would not have entertained for a moment (provided we are right in our suggestion respecting its relations to our fossil) if he had seen a specimen showing a side view of even a few of the segments, with their legs attached. At any rate, our fossil is certainly distinct from the genus *Arthropleura* of Jordan and von Meyer, which is almost beyond doubt a crustacean.

This larger type, for which we have proposed the specific name *major*, not only differs in size from the typical species *armigera*, but also presents the marked difference of having its dorsal scutes much shorter and deeper, in proportion to their size. Indeed, as we are not positively sure that it has two segments below for each one of the dorsal scutes, we are by no means clearly satisfied that it belongs to the same genus as the *armigera*, or that it may not even be much more widely removed from that type. It is therefore only provisionally that we have placed it in this genus. This appearance, however, may possibly be in part due to the oblique manner in which the specimen has been compressed in the matrix.

If other specimens should be found, showing it not to agree with the typical species of the genus *Euphoberia*, in having two segments below for each one above, it will of course have to be removed from that genus, in which case it might be called *Acantherpestes*.

# ARACHNIDA.

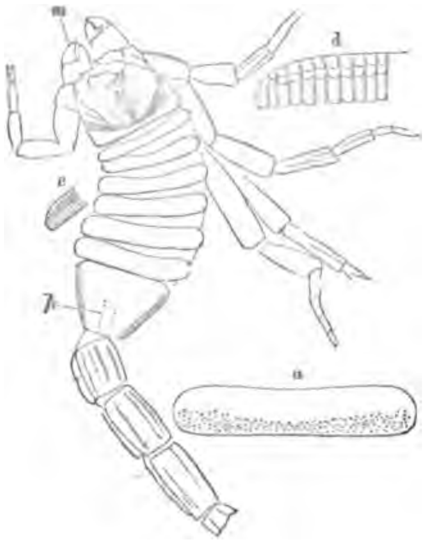
## *PULMONARIA.*

### GENUS EOSCORPIUS, M. and W., 1868.

(Am. Jour. Sci. and Arts (2d ser.), vol. XLV, p. 25.)

### EOSCORPIUS CARBONARIUS, M. and W.

*Buthus?? carbonarius*, MEEK and WORTHEN, 1868. Ibid. p. 24.



***Eoscorpius carbonarius.***

Cut showing the fossil, natural size; (*a*) one of the body segments enlarged to show the surface granules; (*c*) one of the "combs," lying loose in the matrix; (*d*) the same enlarged: (*m*) mandibles somewhat crushed and distorted; (*p*) two rows of minute pits in the last segment of the body.

THE only specimen of this fossil yet known to us consists of a cast and mould as revealed in splitting open a concretion. It shows most of the cephalothorax and mandibles in somewhat crushed condition, the dorsal side of the seven abdominal segments, and three of those of the tail, all in place. Also four of the legs on one side, and one on the other, with one of the peculiar comb-like organs, characteristic of the family *Scorpionidæ*; the latter being detached and lying in the matrix near the side of the abdomen.

The cephalothorax seems to be subquadrangular in form, somewhat wider behind than long, the breadth being about 0.45 inch. Unfortunately it is not in a condition to show the ocelli, nor can we see whether or not its anterior edge is emarginate. It shows a minute marginal line behind, from near which there originates a distinct mesial furrow, which extends forward to near the middle, where it is intersected by, or rather bifurcates into, two oblique furrows, with the prominence for the mesial ocelli between them. Two other rather deep lateral furrows extend, one on each side, from the posterior end of the mesial one, obliquely outward, near the posterior margin. The surface is ornamented with irregular scattering granules, mostly upon the prominences between the furrows. The mandibles are stout, and arranged as in the *Scorpionidæ*, but appear to be without teeth or serrations. The movable finger is curved and sharp at the point. The legs are rather stout, with most of the divisions long. Palpi unknown.

The abdomen is a little more than twice the apparent length of the cephalothorax, or about 0.90 inch in length, and 0.60 inch in breadth. Its segments gradually increase in their antero-posterior diameter, from the front one backward to the seventh, which is about twice and a half as long as the sixth or largest of the others (being 0.35 inch long, and 0.48 inch wide), subtrigonal in form, with the posterior angle broadly truncated for the attachment of the tail, and the anterior lateral angles a little rounded. The six shorter abdominal segments, especially the anterior ones, have their front margin more or less sinuous along the middle, and their lateral extremities more or less rounded. They all have the surface a little granular, the granules being very small and arranged mainly along the posterior margin. The last, or subtrigonal one, also has on its posterior half, near the middle, two longitudinal, parallel rows of minute pits or punctures (*p* of cut).

Of the tail, only the anterior three segments are preserved in the specimen. These show that it was rather stout, but as distinct from the abdomen by its sudden contraction in breadth, and in the form of its segments, as in the existing Scorpions. Its segments measure as follows: first one, 0.26 inch in length, and 0.24 inch in breadth; second, 0.34 inch in length, and 0.22 inch in breadth; third, 0.37 inch in length, and 0.18 inch in breadth. They are all oblong in form, more or less nearly rectangular at their ends, and, as near as can be determined from a flattened specimen, apparently provided above with three or more longitudinal rows of granules, and some scattering ones.

The single detached comb-like organ (c), seen lying in the matrix on the left side of the abdomen, shows some eleven or twelve of the little laminæ or divisions, but apparently had more, as it is incomplete, at least at one end.

Although the discovery of such a type in our Coal Measures, even in the mutilated condition of our specimen, is one of much interest, it is greatly to be regretted that its condition is such as to show no traces of the eyes, either lateral or mesial, or of the palpi and terminal portions of the tail, since these—especially the eyes—are the very parts upon which generic distinctions are based, by most naturalists, who have investigated the existing Scorpions. Consequently, we are left entirely without the means of deciding which of the known genera it would fall into, if not a new generic type. Its general form, however, the structure of its mandibles, and particularly the possession of the peculiar comb-like organs, leave little doubt in regard to its belonging to the family *Scorpionidæ*, as defined by the generality of authors.

On comparison with the only other true Scorpion known to us from the Carboniferous System (*Cyclophthalmus senior*, from the Coal Measures of Bohemia), it will be found to differ remarkably in having its tail as distinct from the abdomen, in form and breadth, as in the modern Scorpions (with which it agrees well in general appearance, so far as its parts are known), instead of having its abdomen passing imperceptibly into the tail, without any well defined change in the form of its segments.

Although our specimen does not retain (excepting in a crushed condition) the anterior part of the cephalothorax, and therefore shows no traces of the eyes, it is evident they could not have been arranged in a large circle around the central prominence for the mesial pair, as is said to be the case in *Cyclophthalmus*,* since the posterior two-thirds of the cephalothorax is well preserved, and would include more than half of the circle of eyes, if they were arranged as in that genus.

A comparison with the recent Scorpions has led us to think it most nearly resembles, in general appearance, the group of species usually included in Leach's genus *Buthus*. In size, and proportions, as well as in the furrows of the cephalothorax and some other characters, we have thought it resembles *Buthus hirsutus*, of Wood, from California, more nearly than any other known American recent form; in which opinion Prof. Wood concurs with us, after examining a sketch we sent to him. From these points of general resemblance, and the necessity for some name by which the fossil can be conveniently referred to, we proposed to designate it, provisionally, until specimens can be found showing the generic characters, as *Buthus?? carbonarius*, but at the same time suggested for it, in case it should be found to be the type of a new genus, the name *Eoscorpius*, in allusion to its early appearance in time. Some eminent Naturalists, however, do not admit the more recent subdivisions of the old Linnæan genus, *Scorpio*, as distinct genera, and if their views should be sustained, our type would almost certainly be included in that genus, and have to be called *Scorpio carbonarius*. Its strict identity with any existing genus, however, is very improbable.

This is the first Scorpion ever found in the Carboniferous rocks of America, and, so far as we know, the first example of the true *Scorpionidæ*, yet found in rocks of that age anywhere. For this unique specimen we are indebted to Mr. M. Prendel, of Morris, Grundy county, Illinois, who found it on Mazon creek, in that county, in the lower part of the true Coal Measures.

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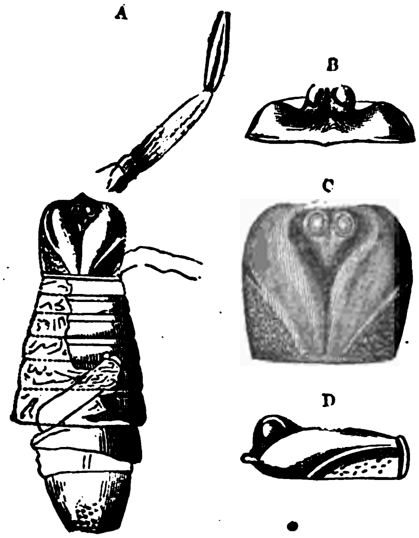
* See Buckland's Bridgewater Treatise, vol. II, pl. 46, fig. 8.

## GENUS MAZONIA, M. and W.

(From **MAZON**, the name of the stream on which so many of these articulate fossils have been found.)

### MAZONIA WOODIANA, M. and W.



*Mazonia Woodiana.*

Fig. A. Showing the cephalothorax, with portions of the abdominal segments in a crushed condition; and parts of one of the palpi. (Nat. size.)

Fig. B. An anterior view of the cephalothorax, enlarged about two diameters, showing the large eyes on the sides of the mesial prominence.

Fig. C. View of the upper side of the cephalothorax, enlarged two diameters, some parts of the margin being restored.

Fig. D. Side view of same.

THE only specimen of the type of this proposed genus and species yet known, is in a crushed condition, and of course shows but few of its characters. Its cephalothorax is moderately convex, of a sub-quadrangular form (its length being about 0.44 inch, and its breadth 0.41 inch), with rounded anterior lateral margins, and the anterior margin transversely truncated on each side of a small triangular mesial projection. Its posterior lateral regions slope off abruptly from an obscure ridge extending obliquely forward and outward, from near the middle of the posterior margin, to a point near the middle of each side, the sloping surface being marked by a few very minute irregularly scattering granules. From near the posterior margin, a mesial furrow extends forward, widening and deepening rapidly to the front, where it occupies about one-third of the entire breadth, and is partly filled by the oculiferous prominence, which is the most elevated part, and bears on each side a large eye. These mesial eyes (the only ones known, or believed to exist) are circular, convex, about seven to eight-hundredths of an inch in diameter, and arranged for looking obliquely forward, outward and upward. They are each surrounded by a ridge, and so much elevated as to be seen almost entirely above the surface of the cephalothorax on each side. *No traces of lateral eyes* can be seen in the specimen, even by the aid of a magnifier, although the anterior lateral margins (particularly on one side) are well preserved.

The abdomen measures about 1.32 inches in length, and near 0.56 inch in breadth, as seen in its crushed condition. There appear to be at least seven segments, with just space enough between the anterior, or seventh one seen, and the cephalothorax, for an eighth one. Excepting the posterior one (which is ornamented on the central region of the posterior half with small granules, some of which are arranged in longitudinal rows), these segments seem to be smooth. The exact outline of the posterior segment is not clearly seen in the specimen, though it has evidently very nearly the size and form represented in figure A. In clearing away the matrix, its posterior margin was seen to be truncated, as if for the attachment of a stout tail, but in trying to work away more of the matrix, its margin was broken away, so that it does not now show the truncated edge so clearly as represented in the figure. Its lateral margins are somewhat flattened. No traces of the tail are preserved, the concretion being too small to have included it.

Just in front of the cephalothorax, extending obliquely forward, and outward to the right, a part of apparently one of the palpi is seen in the matrix. Unfortunately, however, its terminal portion is broken away. It seems to have been long and slender. At the inner end, there appears to be but one, though there may be two, short joints, and beyond these, there are two long slender ones, of the size and form (as flattened in the matrix) seen in figure A. An obscure impression of a part of one of the legs is also seen farther back, extending out from the right side.

The portions of the figure A represented in continuous lines, can be made out with a reasonable degree of confidence in the specimen, while the portions restored are represented in dotted lines. It is proper that we should state, however, that the little triangular mesial projection of the anterior margin represented in figure A, was actually seen, though represented with dotted margins, because it was afterwards broken away in attempting to clear away the matrix.

It is possible that this form may be more nearly allied to the last than would appear from the examination of the specimens yet found, especially as we at this time know nothing of the nature of the eyes, in the first described type, the anterior portion of the cephalothorax of which is wanting in the only specimen known. From the apparent form of the abdomen, however, of the type under consideration, and its apparent greater number of segments, as well as from the differences seen in the ridges and furrows of the cephalothorax, we are inclined to think these types will be found to be widely distinct. Indeed, the general close resemblance of the type of *Eoscorpius* to the modern true Scorpions, would, from analogy, lead to the conclusion that it probably has lateral eyes, while the presence in the type under consideration, of only the mesial pair, as well as its apparent number of abdominal segments, lead us to suspect that it may be found to combine some of the characters of the Pseudo-scorpions with those of the true Scorpions. These questions, however, can hardly be settled by such specimens as have yet been found.

The form under consideration appears to be more widely removed from modern types than that for which we have proposed the name *Eoscorpius*, none of the existing true Scorpions being, we believe, without lateral eyes. It is barely possible that our type may have possessed very minute rudimentary lateral eyes, though we have been unable to find any traces of them after frequent careful examinations, in various lights, by the aid of good magnifiers. The large size, elevation, direction and anterior position of the mesial pair, would also favor the conclusion that there were no lateral eyes.

We take pleasure in naming this interesting fossil in honor of Prof. H. C. Wood, of Philadelphia, who has given more attention to the recent Scorpions and *Myriapoda* than perhaps any other person in this country.

For the specimen on which this description is based, we are indebted to Mr. S. S. Strong, of Morris, Illinois.

*Locality and position:* Mazon creek, Grundy county, Illinois; from the lower part of the true Coal Measures.

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NOTE ON THE GENUS *Palæocampa.*—The only specimen of this fossil known, at the time it was described, did not show the *substance* of the little hair-like bodies projecting from it in densely packed tufts, but only casts and moulds of them, composed of the same ferruginous material as the matrix. This specimen was unfortunately destroyed by a fire at Morris, along with many other valuable fossils belonging to Mr. Even, from the Mazon creek locality. Recently, however, a much better specimen of it has been found at the same place; and, on examining it under a good magnifier, we find that the hair-like bodies, although appearing very slender, to the unassisted eye, are really little rigid *calcareous spines*, distinctly stouter than the hairs usually seen on Caterpillars, and without any traces of the minute lateral barbs generally characterizing the same. In addition to this, these little delicate spines show, under a strong magnifier, in a cross light, very regular, longitudinal, microscopic striæ, much like those often seen on the spines of Echinoids, though its body was evidently soft, rather slender, and without any calcareous or other kind of hard covering.

Not having at hand, for examination, any of the setæ of the Annelids, we wrote to Dr. Packard, of the Peabody Academy of Sciences, informing him of the results of our farther examinations of the apparent hairs of *Palæocampa*, and making inquiries in regard to the microscopic appearance of the setæ of worms—such, for instance, as those of *Aphrodita.* Dr. P. was kind enough to make the examination, and writes that he finds the long, silky hairs, from near the head of *Aphrodita*, to show, under a magnifier of about fifty diameters, fine, regular, longitudinal striæ.

From these facts, it seems very improbable that *Palæocampa* is a Caterpillar, but that it is more probably a worm, as suggested by Professor Scudder. If farther examinations should confirm this view of its affinities, and the name *Palæocampa* should therefore be considered objectionable, it might be called *Desmacanthus*, in allusion to the fasciculated character of its delicate needle-like spines.

# SUPPLEMENT TO DESCRIPTIONS OF ARTICULATES.

## DESCRIPTIONS OF FOSSIL INSECTS,

### FOUND ON MAZON CREEK, AND NEAR MORRIS, GRUNDY CO., ILL.

BY SAMUEL H. SCUDDER.

THE fossil insects of the iron-stone nodules of Mazon creek, were first made known by Prof. Dana, under the names of *Miamia Bronsoni* and *Hemeristia occidentalis*. These two species of Neuroptera were afterwards shown by me to form types of new families, which I called *Palæopterina* and *Hemeristina*. The *Palæopterina* are now represented by two additional species, one belonging to *Miamia*, and the other to a distinct genus. The two specimens before me, with wings better preserved than in the individual of *Miamia Bronsoni*, prove that my delineation of the conjectural parts of the wing-structure of the *Palæopterina* was in part erroneous, and give evidence of a closer relationship of the *Palæopterina* to the ancient *Termitina* than I had supposed possible. A revised description of the essential features of the wing will be given at another time.

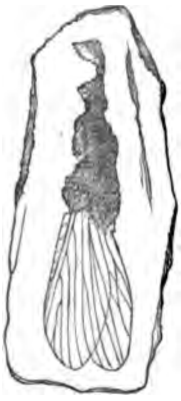

Fig. 1—*Miamia Danæ*.

I. For the new species of *Miamia*, I propose the specific name of *Danæ* (fig. 1). It is a little (four-fifths) smaller than *M. Bronsoni*. The principal veins of the costal half of the upper wing do not divaricate so widely, nor in exactly the same manner as in *M. Bronsoni*, and the cross-veins are not similarly situated. These differences will be made apparent by the figure. The fossil consists mainly of the four overlapping wings, which are partially obscured in the middle, and imperfect at the base. The body is too vague for any description. A fragment of one of the legs does not differ from that of *M. Bronsoni*. The wings, when at rest, seem to overreach the abdomen by one-eighth of their length.

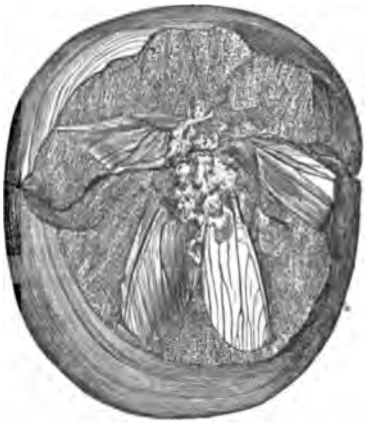

Fig. 2.

II. The other fossil which I would refer to the *Palæopterina* is *Chrestotes lapidea* (fig. 2). The genus differs from *Miamia* in the shortness and rotundity of the wings, and in the very striking prominence, in the upper wings, of the vein which separates the anal field from the remainder of the wing. In this respect, the wing resembles the tegmina of some *Blattariæ*.

This species has short, broad and well-rounded wings. Enough of them remains to enable us to judge that the *vena scapularis* throws several branches downward, commencing before the middle of the wing, and that it occupies, with its branches, the upper two-fifths of the upper wing, and perhaps more of the lower one. The remainder of the wing is mainly occupied by the longitudinally divaricating branches of the next two veins. In the upper wing, the anal area (distinctly set off from the remainder of the wing) occupies the basal portion of the wing, and probably extends half way along the inner border. The breadth of the hind wing is 8½ mill.; the estimated length of the same 22 mill. In this specimen, also, the body is too vaguely defined to admit of description, but the wings appear to reach beyond the abdomen by at least one-fourth of their length.

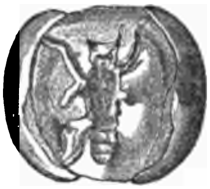

Fig. 3.

III. A third insect (fig. 3), found in the nodules, has much the appearance of a small wingless *Mantis*, but is very poorly preserved. It is 13 mill. in length, of nearly uniform breadth throughout, with the anterior outer angles of the head produced triangularly, apparently like the eyes of an *Acanthops*. The abdomen is best preserved; it is short, the terminal six joints nearly equal (the third from the end being longest) and quite distinct. It is regularly curved, and terminates in a rounded point, with no trace of appendage. The legs are long. The coxa, femur and tibia of the anterior pair are nearly equal, similar, very broad and short, and carinated along the median line. Two or three joints only of tarsi are visible: these are of about the length of the tibia, but much more slender, and possibly raptatorial. The hind legs are similar, but the tarsi are

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NOTE.—The figure of this fossil (No. III) is defective in not showing the joints of the legs. The specimen shows, in the anterior leg on the left side, five distinct joints, about 0.08 inch in length; while from some of the joints a few little pits may be seen penetrating the matrix, which appear to have been made by spines such as we see along the legs of the associated Crustacean *Acanthotelson*, of which we were inclined to think this might be a mutilated specimen, but Prof. Scudder thinks it more probably an Insect.

F. B. M. and A. H. W.

not represented on the stone. The middle pair of legs are vague and broken. The fore legs are about 8¼ mill. in length. The affinities of this insect are so dubious that I refrain from attaching a name to it, until other specimens are found to throw light upon its relationship.

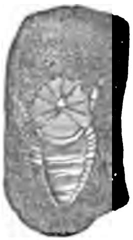

Fig. 4.

IV. The last of the nodule specimens (fig. 4) is perhaps the most interesting. I believe the remains to be those of an Arachnid. This is the first discovery of a fossil spider in America, and, as far as I know, only the fourth instance of the occurrence of *Arachnidæ* in carboniferous strata.* In 1835 and 1839, Corda first figured two species—one a true Scorpion, the other a gigantic Pseudo-scorpion. Recently, Rœmer has described a true spider, under the name of *Protolycosa*. Thus the three known carboniferous *Arachnidæ* represent three distinct families of Octopods. The one figured here (*Architarbus rotundatus*) seems to belong to a fourth family, being allied to the *Phalangidæ* and to the *Phrynidæ*. In its fragmentary state, one can scarcely judge with certainty of its exact relationship. The arrangement of the legs accords equally well with both families. The broad attachment of the thorax to the abdomen is a phalangidan characteristic, while the size and shape of the abdomen, the number of the abdominal segments and the crowded state of the central portions of the basal ones indicate closer affinities to the *Phrynidæ*.

The under surface of the thorax and abdomen are exposed to view, together with a fragment of one of the legs. The thorax is nearly circular; the arrangement of the coxæ uniformly radiate; the two joints of one leg are of equal length, and broader at the apex than at the base. The abdomen is nearly as broad at the base as the thorax; it broadens close to the base, and beyond is ovate. The first abdominal segment is scarcely perceptible at the sides, very large in the middle, crowding downwards the four succeeding segments, which are short and bowed. The terminal three segments are long and straight, the last having just at the tip, but on the under surface, the circular anal opening. Laterally all the segments are depressed, and thus a broad, flat border is formed on either side. Length of the specimen, 18½ mill.; length of the thorax, 8½ mill.; breadth of the thorax, 9 mill.; greatest breadth of the abdomen, 9 mill.; length of the longest abdominal segment, 1½ mill.; length of one leg-joint, 3¼ mill.; breadth of the flattened margin of abdomen, ¾ mill.

V. Among the remains of insects sent from Illinois, are an upper wing and a frontal shield of a cock-roach, both apparently belonging to the same species. The venation of the wing differs so much from any of the living or extinct forms known to me, that I place it in a new genus, and describe it under the name of *Mylacris anthracophila*. It is apparently a member of the family *Epilampridæ*, as defined by Brunner. Living types of the family are confined, in general, to hot countries, none having yet been discovered in America north of Mexico, in Europe, in North Africa, or in any of the southern parts of Asia.

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* At the time this was written, the description of *Eoscorpius carbonarius* had not been published, and the other type, described in this volume under the name *Masonia*, was unknown.

This species has no generic relation with the Carboniferous *Blattariæ* hitherto found in America, nor with any of the fossil cock-roaches of England, figured by Brodie and Westwood. It has closer affinities with the *Blattariæ* found in the Carboniferous rocks of Saarbruck, described by Goldenberg, and with the Wettin cock-roaches figured by Germar. Giebel, in his Fauna der Vorwelt, has grouped all the Carboniferous species under *Blatta* and *Blattina*. Heer, in his review of the fossil cock-roaches,* has brought the species of the Coal Measures under three divisions of the genus *Blattina*. Our present species, and both of those previously known in America, belong to his first section, in which the interspaces in the wing are broken up by straight cross-veins, forming quadrangular cells; † but the differences in the mode of divarication of the veins seen in the species grouped under that section, seem to me to indicate the presence of several genera wrongly associated under one name.

The wing (fig. 5), which is a right upper one, almost perfectly preserved, is large and broad, its inner border nearly straight, bent abruptly at the inner angle; the outer border, regularly curved, meets the inner border so as to form a somewhat produced apex (the extremity is defective). The inner field of the wing is pretty large, swollen, separated from the rest of the wing by a deep sulcation, and extends along the inner border for about two-fifths of its length. It is filled with regular, prominent veins, all of which terminate independently and at regular distances along the inner border. The other veins of the tegmina are spread almost uniformly and somewhat fan-shaped over the rest of the wing, forming no very prominent ridge or line of demarcation along the median line. The interspaces are divided rather regularly by inconspicuous straight cross lines. Length (estimated), 28½ mill.; greatest breadth, 13½ mill.

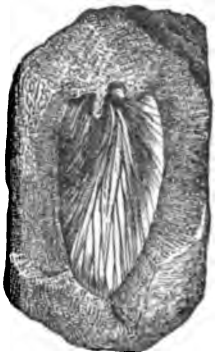
Fig. 5.

The pronotal shield (fig. 6) occurs upon another piece of shale. It is quite perfect, and of a size rendering it possible to suppose that the shield and the wing belonged to the same individual. Both the anterior and posterior borders are well, regularly and nearly equally rounded. The sides are straight, but so strongly convergent anteriorly that the pronotum is nearly twice as broad behind as in front. The posterior border has a narrow, slightly raised edge; the surface is only a little

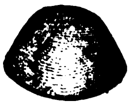
Fig. 6.

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* Vierteljahrsschrift der naturforschenden Gessellschaft in Zurich, ix, 275.

† The only species in his second group (*Blattina gracilis*, Gold.) in which the principal veins of the wing are united at the base, appears to belong properly to the first section—Goldenberg's figure, on which it is based—being, without doubt, inaccurately drawn.

convex, nearly smooth, with a few minute, transverse and longitudinal lines. Width between posterior angles, 16 mill.; width between anterior angles, 9½ mill.; greatest length, 12 mill. The two last named specimens are from Colchester, Illinois.

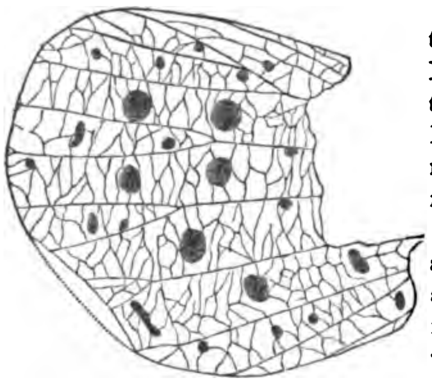

Fig. 7.—*Megathentomum pustulatum.*

Among the fossil insects found in the iron-stone concretions of Morris, Illinois, which I have been permitted to examine, through the kindness of Prof. Worthen and Mr. Leo Lesquereux, is the following very remarkable form:

The fragment (fig. No. 7) represents a wing—apparently an upper one—of a neuropterous insect. It is gigantic in size, very broad, with distant nervures, simple infrequent divarications, and, in the outer half of the wing, which alone is presented, a cross neuration, composed solely of most delicate and irregular veinlets. The wing is also furnished with a great number of larger and smaller discolored spots, the surfaces of the larger ones irregularly elevated.

The *vena mediastina* is simple and straight. The *vena scapularis* sends out two branches from its upper side, the first of which does not reach the border, but loses itself in a congeries of minute veins; while the second, branching again quite near its origin, supports the tip of the wing. The *vena externo media* occupies the middle third of the wing, and divides once near the base. Each branch is quite straight, and forks again—the upper one a little nearer the border than the second divarication of the *vena scapularis;* the lower, still nearer to the margin. The *vena interno media* divides several times, the uppermost branches forking again just inside of the border. The *vena analis* does not appear on the fragment.

There are six larger round or squarish spots. Four compose a bent row, a little beyond the middle of the wing; three (sub-parallel to the outer border forming a nearly straight line, while the lowest is turned inward, at a little more than a right angle. The uppermost spot occurs in the interspace between the *vena scapularis* and *externo media;* the others follow in succeeding interspaces. The fifth and sixth large spots are found in the same interspaces with the upper two of the inner row, and are situated about half way between them and the border. The smaller spots appear to be less regularly distributed; they are usually round, but sometimes oval or elongated. There are three at equal distances from each other in the lower outer interspace formed by the branches of the *vena scapularis.* One occurs just within and above the inner of three just mentioned, and one near the angle of the last divarication of the *vena scapularis.* There are two between the forks of the upper branch of the *vena externo media*, two between the forks of the lower branch of the same, and, in the interspace between the branches, one spot is found close to the margin. Two larger and elongated spots occur in the same interspace with the lowest of the four large spots, and three equidistant round ones in the next interspace below. In the succeeding interspace, probably about half way between the base and the outer border, there is a small oval spot. Finally, two faint ones are situated upon and beneath each of the branches of the *vena externo media*, near the middle of the wing.

The wing was probably a little more than three inches long; its greatest breadth, measured by a line at right-angles to the costal border, is 1.08 inches; from the apex of the wing where the upper branch of the *vena scapularis* touches it, to the lowest point of the lower outer angle, 2.01 inches; from the center of the upper, inner large spot to the outer margin, 1.05 inches; greatest breadth of an interspace, 0.34 inches.

This insect is allied to the *Coniopterygidæ* by the simplicity of its neuration, but differs from that family not only in the cross-veining, but in the mode of branching and the proportion of the wing allotted to each of the veins. It appears to belong to a family hitherto undescribed. I do not know of a single insect, living or fossil, which approaches it in the structure of the wings. The spots on the wing form a most remarkable feature.

The following specimens on shale, represented by figures 8, 9 and 10, appear to be the wings of insects, and being probably more nearly allied to the *Euphemeridæ* than to other *Neuroptera*, should be grouped under the generic name *Euphemerites:*

No. 8 may be called *Euphemerites simplex*, in which the wing veins are seen to diverge from and approach each other irregularly, one portion or wing forming gentle sinuations which the other does not.

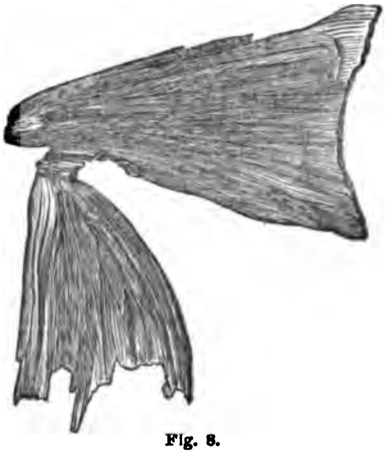

Fig. 8.

No. 9 may be called *Euphemerites gigas*, and resembles somewhat, in its outline, the fin of a fish. It is composed of straight veins, forking feebly, with very slight divarications,

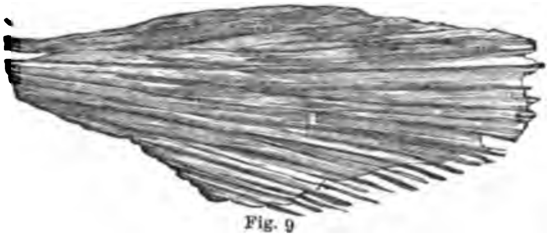

Fig. 9

crowded so closely upon one another, that the wing cannot be compared with that of any known insect; and yet I do not know why *Neuróptera* of an exceedingly low structure may not once have had such wings.

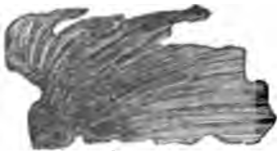

Fig. 10.

No. 10, with curved veins, may be called *Euphemerites affinis.* In this specimen the veins, instead of being nearly straight, are very strongly curved; they are numerous as in the other species, and fork in a similar manner; their origin is too vague for any determination, since they fade out before reaching the base.

The specimens in iron nodules are all from Mazon creek, and those on shale from the roof of the coal seam near Morris, except Nos. 5 and 6.

NOTE.—In the foregoing figures 8, 9 and 10, the engraver has unfortunately mingled the lines of shading with those intended to represent the veins, so as to render the latter scarcely distinguishable. No. 8 is enlarged nearly two diameters. The others are natural size.

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# APPENDIX.

## CHEMICAL ANALYSES.

PROF. A. H. WORTHEN,
*State Geologist of Illinois:*

SIR—I respectfully report the following analyses, made by me, at your request.
J. V. Z. BLANEY.

No. 1.—*Name:* Hydraulic Limestone. *Formation:* Lower Carboniferous. *Group:* St. Louis. *Locality:* Four miles south-east of Carrollton, Greene county, Illinois:

| | |
|---|---|
| Clay and insoluble matter | 23.49 |
| Carbonate of lime | 44.90 |
| Carbonate of magnesia | 25.44 |
| Peroxide of iron | 5.21 |
| Soluble silica | none. |
| Alkalies, loss, etc | .96 |
| | 100.00 |

No. 2.—*Name:* Hydraulic Limestone. *Formation:* Lower Carboniferous. *Group:* St. Louis. *Locality:* Thompkins' Mill, Greene county, Illinois:

| | |
|---|---|
| Clay and insoluble matter | 48.53 |
| Carbonate of lime | 30.70 |
| Carbonate of magnesia | 16.31 |
| Peroxide of iron | 2.75 |
| Soluble silica | none. |
| Alkalies, loss, etc | .49 |
| | 98.78 |

No. 3.—*Name:* Hydraulic Limestone. *Formation:* Upper Silurian. *Group:* Niagara Limestone. *Locality:* Four miles north of St. Charles, Kane county, Illinois:

| | |
|---|---|
| Clay and insoluble matter | 11.60 |
| Carbonate of lime | 40.86 |
| Carbonate of magnesia | 43.54 |
| Peroxide of iron | 1.40 |
| Soluble silica | none. |
| Alkalies, loss, etc | 2.60 |
| | 100.00 |

No. 4.—*Name:* Hydraulic Limestone. *Formation:* Devonian. *Group:* Hamilton. *Locality:* Grafton, Jersey county, Illinois:

| | |
|---|---|
| Clay and insoluble matter | 23.13 |
| Carbonate of lime | 59.30 |
| Carbonate of magnesia | 16.08 |
| Peroxide of iron | 1.00 |
| Soluble silica | none. |
| Alkalies, loss, etc. | .49 |
| | 100.00 |

No. 5.—*Name:* Hydraulic Limestone. *Formation:* Upper Silurian. *Group:* Niagara. *Locality:* Blue Island, Cook county, Illinois:

| | |
|---|---|
| Clay and insoluble matter | 43.56 |
| Carbonate of lime | 31.60 |
| Carbonate of magnesia | 22.24 |
| Peroxide of iron | 1.20 |
| Soluble silica | .16 |
| Alkalies, loss, etc | 1.30 |
| | 100 26 |

No. 6.—*Name:* Limestone. *Formation:* Devonian. *Group:* Oriskany. *Locality:* Bald Rock, Jackson county, Illinois:

| | |
|---|---|
| Clay and insoluble matter | 1.56 |
| Carbonate of lime | 37.25 |
| Carbonate of magnesia | 60.00 |
| Peroxide of iron | .80 |
| Soluble silica | none. |
| Alkalies, loss, etc | .39 |
| | 100 00 |

**Section of Coal Seam** *at Jones' shaft, on the south-west quarter of section* 14, *township* 6, *range* 5 *west, near Georgetown, in Randolph county, Illinois, as observed by Colonel J. W. Foster. Analyses by Dr. Blaney.*

| Layers. | Thickness. | Water at 300°. | Fixed carbon. | Vol. com. matter. | Ash. | Color of ash. |
|---|---|---|---|---|---|---|
| 1. (Blacksmith) | 20 inches. | 6.310 | 62.753 | 28.687 | 2.250 | White and flocculent |
| 2. (Peacock) | 14 do. | 7.500 | 50.000 | 40.625 | 1.875 | do. do. |
| 3. (Middle) | 21 do. | 9.250 | 46.688 | 29.500 | 5.812 | Faint lavender |
| 4. (Block) | 18 do. | 6 225 | 61.575 | 26.500 | 5.800 | Pure white |
| 5. (Bottom) | 16 do. | 8.475 | 56.245 | 25.280 | 10.000 | Faint shade of brown |
| 7 feet, 5 inches | 89 inches. | | | | | |

Note.—The analyses of iron ores, clays, etc., intended for this volume, have not been completed, and their publication is necessarily deferred. A. H. W.

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# ERRATA.

Nearly all of the following errata, and a few others of less importance, would have been corrected before printing, if the work had been stereotyped; but as it was printed off directly from the types, as fast as each form was ready, they were not observed in time for correction, excepting a portion of them in a part of the edition:

Page 21, 14th line from top, for "town 14 east," read "town 14 south."
Page 47, 11th line from top, for "sandstones," read "limestones."
Page 65, 9th line from top, for "southwest," read "northwest."
Page 184, 8th line from bottom, for "bed of the rock," read "bed of the creek."
Page 207, 19th line from bottom, for "father," read "farther."
Page 214, last line below, for "oblain," read "obtain."
Page 218, 8th line from top, for "*saicharinum*," read "*saccharinum*."
Page 224, 20th line from bottom, for "Quarternary," read "Quaternary."
Page 231, 14th line from top, for "has," read "have."
Page 249, 6th line from top, for "Swagey," read "Swazey."
Page 251, 27th line from top, add figures 18, after section.
Page 253, 13th line from top, for "*Pleurotamaria*," read "*Pleurotomaria*."
Page 253, 18th line from top, for "*Niagarense*," read "*Niagarensis*."
Page 254, 7th line from the top, for "peculiarity," read "peculiarly."
Page 258, 24th line from top,, for "agree," read "agrees."
Page 260, 19th line from the top, for "*Vitis estrialis*," read "*Vitis æstivalis*."
Page 261, 6th line from top, for "St. Peters Limestone," read "St. Peters Sandstone."
Page 266, 20th line from bottom, and page 267, upper line, for "*Aviculopecten Coxanus*," read "*Aviculopecten rectilateraria*."
Page 291, 6th line from the bottom, for "pinulæ," read "pinnulæ."
Page 292, 1st line below, page 294, 14th and 15th lines from bottom, page 295, 5th and 22d lines, and page 296, 15th line from top, for "hight," read "height."
Page 304, 8th line from bottom, for "diaphragus," read "diaphragms."
Page 305, 8th line from top, for "genus," read "genera."
Page 334, 7th line from top, for "seem," read "seems."
Page 336 11th and 22d lines from the top, for "*L. rhomboidalis*," read "*S. rhomboidalis*."
Page 349, 6th line from top, for "*Megestocrinus*," read "*Megistocrinus*."
Page 358, 4th line from bottom, for "figure," read "fissure."
Page 353, 14th line from bottom, for "*glans-faga*," read "*glans-fagea*."
Page 356, 10th line from top, for "1865. Report Regents, etc.," read "1865. Paper issued in advance of 18th Report Regents, and finally printed in 20th Report."
Page 357, 12th line from bottom, for "septura," read "septum."
Page 357, 7th line from top, for "*propinquua*," read "*propinqua*."
Pages 368, 390, 416, 447 and 460, in the headings, the name of the class *Crustacea* should have been printed in the same heavy type used elsewhere for the names of classes.
Page 368, 11th line from bottom, for "*Irwensis*," read "*Iowensis*."
Page 369, 15th line from bottom, add the initials "M. and W." after *Striatopora Missouriensis*.
Page 370, 1st line at top, for "this specie," read "this species."
Page 373, 3d line from top, for "*subcrinata*," read "*subcarinata*."
Page 375, 14th line from bottom, for "biparlite," and "bipartite."
Page 378, 22d line from bottom, for "a narrow foramen," read "the narrow foramen."
Page 383, 6th line from bottom, for "*Cystina*," read "*Cyrtina*."
Page 384, erase 18th line from bottom.
Page 402, 3d line from top, for "*P. ovalis*," read "*R. ovalis*."
Page 403, 8th line from bottom, for "all four," read "all of our."
Page 409, 2d and 7th lines from bottom, and page 410, 12th line, for "fosset," read "fossette."
Page 411, 8th line from bottom, for "dorsal valve," read "ventral valve."
Page 421, 6th line from bottom, for "abnornally," read "abnormally."
Page 424, 11th line from bottom, for "Sarkatchewan," read "Saskatchawan."
Page 425, 2d line from bottom, for "Athebasca," read "Athabasca."
Page 431, 4th line from the bottom, for "distint," read "distant."
Page 459, 17th line from below, for "*Gyroceras? Rockfordensis*," read "*Gyroceras? Rockfordense*;" also, same page, insert *Cephalopoda* above genus *Gyroceras*.
Page 485, 5th line from the bottom, for "somewhat larger," read "somewhat longer."
Pages 499 and 526, the name of the order *Asteroidea*, and page 522, that of the order *Echinoidea*, are wrongly printed in the type elsewhere used for classes.
Page 541, 2d line from bottom, for "anterior," read "posterior."
Plate 7, in 3d line of heading, for "*Dithyris*," read "*Delthyris*."

We have not had access to Sowerby's Mineral Conchology, excepting the German translation, in which the arrangement of pages, etc., is changed. In referring to other authorities for the date of the genus *Productus*, we observe they differ as follows: Bronn, Prof. Agassiz (Nom. Z.) and d'Orbigny cite it 1812—Bronn giving Vol. I, p. 153; while de Koninck, Davidson, King and Herrmannsen cite it 1814—King also giving Vol. I, page 153. The former date is probably that on the title page, and 1814 that of the *actual issue* of Vol. I of the Min. Conch. This disagreement between the authors to whom we at different times referred, not being at first observed, has caused some discrepancies in our citations of the genus *Productus*, in this and the preceding volume.

We also cited the genus *Pterinea*, in the second volume, from Goldfuss' Petref. Germ., which bears the date 1826–1833, as follows: "*Pterinea*, Goldfuss, 1833, Petref. Germ. II, p. 133." We have since observed, however, that according to Herrmannsen and others, this genus was actually published in 1832, which latter date we have given in this volume.

The following errata, in the Introduction to Vol. II, were only corrected in a part of the edition, and should have been included in the list of errata: Page XII, 1st, 5th and 10th lines from top, and page XIII, 15th line from top, for "shaley," read "shaly." Page XIII, 5th line from top, and page XIV, 3d line from top, for "*Stricklandiana*," read "*Stricklandinia*." Also, page XIV, 5th line from bottom, for "*Atripa*," read "*Atrypa*."

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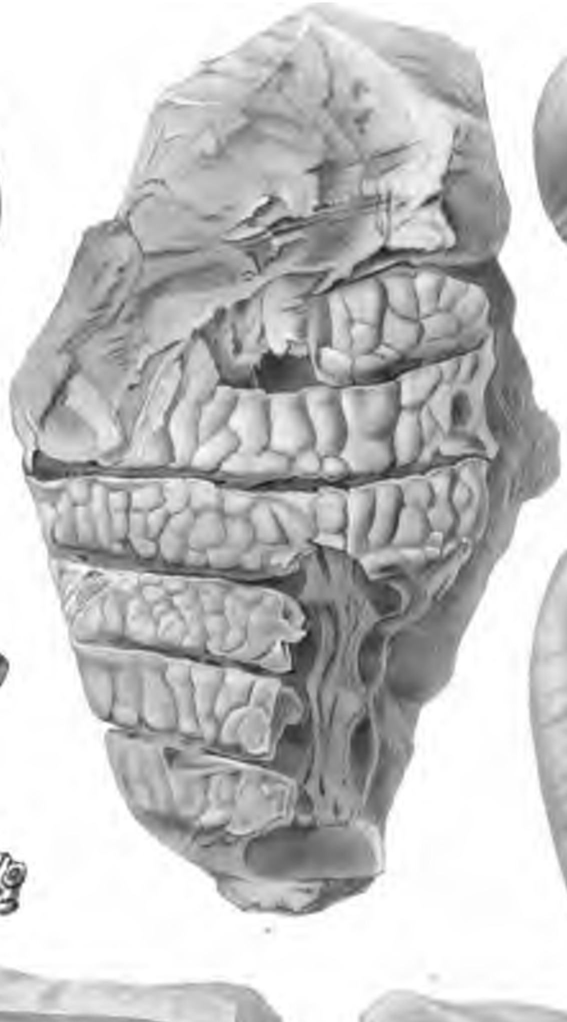
# GEOLOGICAL SURVEY OF ILLINOIS

LOWER SILURIAN [illegible] MISCELLANEOUS



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# PLATE II.

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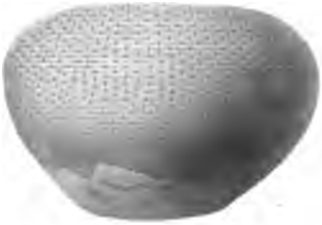
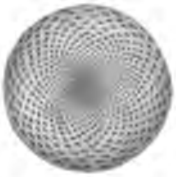
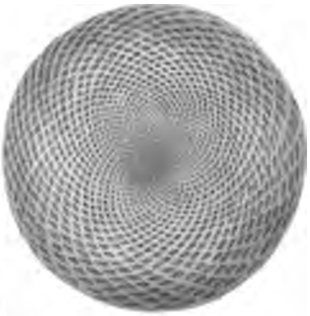
9 *b.* Side view of same.

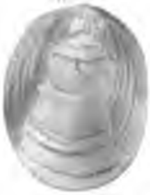
# GEOLOGICAL SURVEY OF ILLINOIS

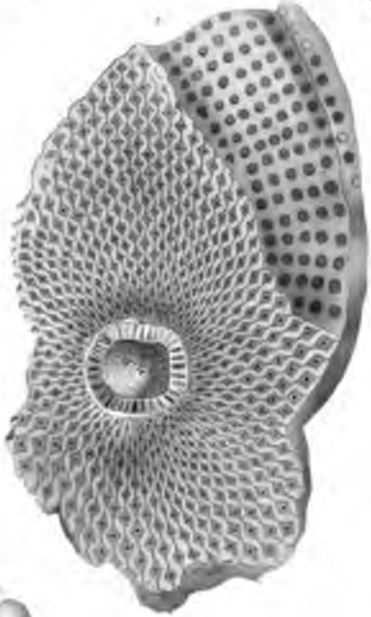
LOWER SILURIAN [illegible] RADIATA & MOLLUSCA

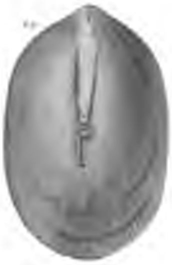


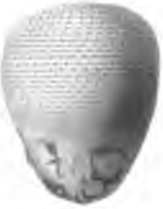


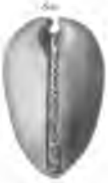


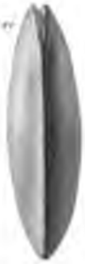


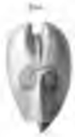


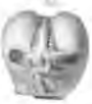


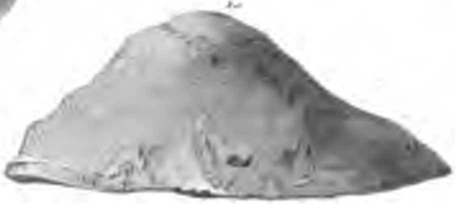


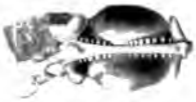


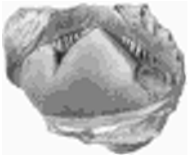


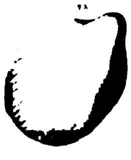


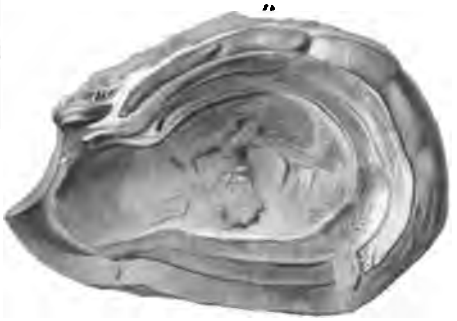


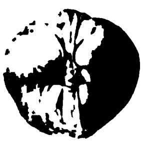












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# PLATE III.

PAGE.

Fig. 1. **ILLÆNUS CRASSICAUDA**, Wahlenb.??..........................322

1 *a.* Dorsal view, showing the pygidium and thorax; and posterior margin of the head. [The pygidium should have the anterior lateral margins truncated, instead of produced and acutely angular.]

1 *b.* An imperfect view of the glabella, with a part of its posterior margin obliquely folded under, and the cheek on the right flattened out by pressure.

Fig. 2. **ILLÆNUS TAURUS**, Hall..........................................320

Dorsal view of a cast, the head being arched over, so that only about one-half of its full length is seen.

Fig. 3. **ORTHOCERAS ANELLUM**, Conrad........................................318

View of a part of internal cast. [Septa and annulations too oblique.]

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Fig. 5. **TROCHONEMA UMBILICATA**, Hall? (sp.)..........................314

5 *a.* Front view of internal cast.

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Fig. 6. **OPHILETA OWENANA**, M. and W........................................313

6 *a.* View of under side of an internal cast.

6 *b.* Anterior profile view of same inverted, the specimen being so imbedded in the matrix that it could not be well drawn with the dorsal side above.

Fig. 7. **RAPHISTOMA LENTICULARIS**, Conrad (sp)..........................316

7 *a* and *c.* Under and profile views of a specimen referred doubtfully to this species.

7 *b.* Upper view of an internal cast of a larger specimen.

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8 *a.* Side view of an internal cast with the expanded lip mainly broken away.

8 *b.* Dorsal view of same.

Fig. 9. **CYPRICARDITES** ———?....................................311

9 *a.* Right side view of an internal cast.

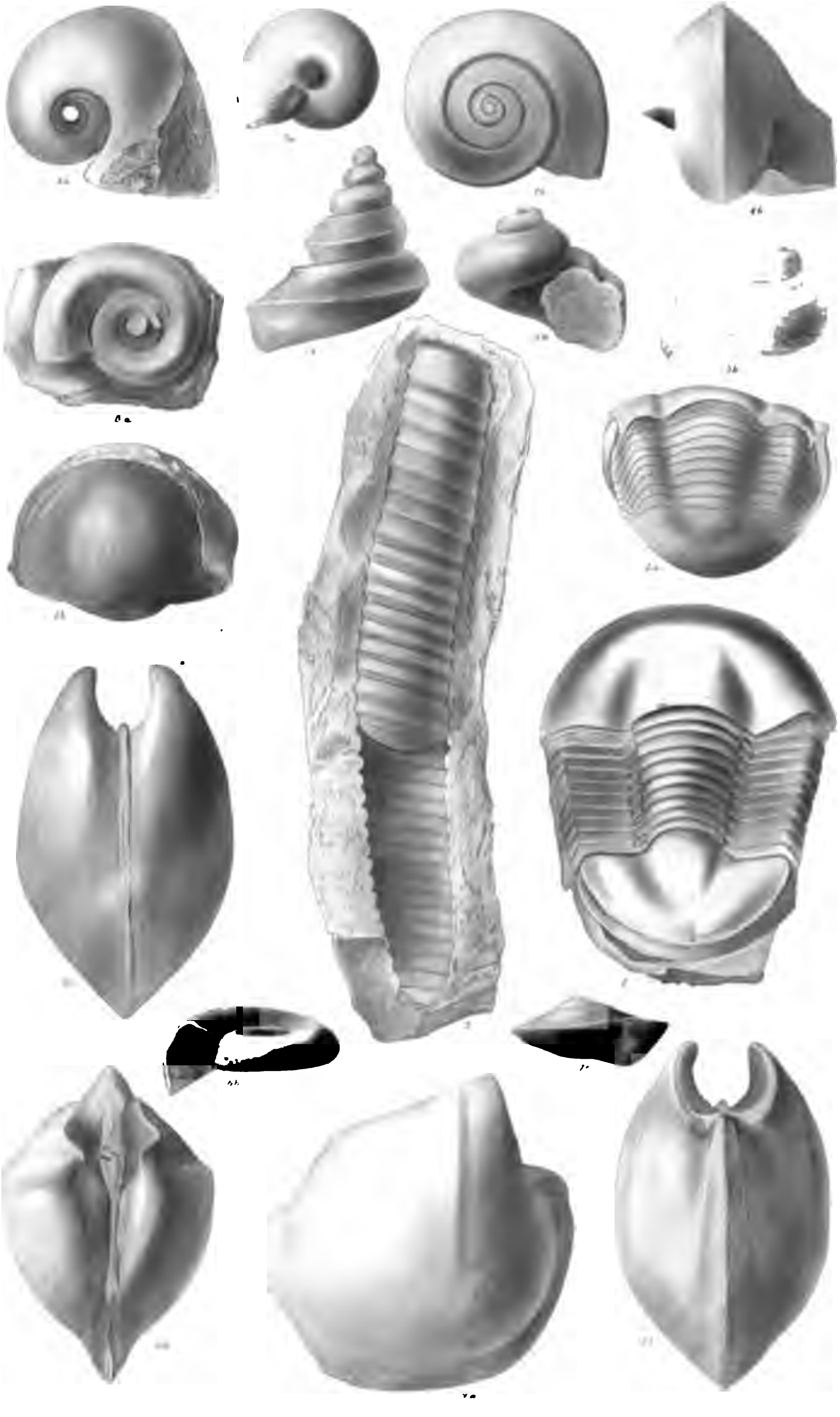
9 *b.* Anterior view of same.

9 *c.* Posterior view of same.

9 *d.* Cardinal or dorsal view of same.

# GEOLOGICAL SURVEY OF ILLINOIS

**LOWER SILURIAN** (Galena Formation) **CRUSTACEA & MOLLUSCA**



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# PLATE IV.

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Fig. 1. Heterocrinus crassus, M. and W ........................324

1 *a*. Side view of body and portions of the free rays.

1 *b*. Opposite view of same.

1 *c*. View of the body of another specimen, with the pentagonal column attached.

Fig. 2. Porocrinus crassus, M. and W...... ........................330

2 *a*. Posterior view of body, showing the arrangement of the anal and other plates on that side, and the position of the anal opening above.

2 *b*. Anterior view of same.

Fig. 3. Hybocrinus? incurvus, M. and W........................327

3 *a*. Lateral view of body and portions of the arms, with a few joints of the column attached.

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Fig. 4. Dendrocrinus? Oswegoensis, M. and W....................333

Posterior-lateral view of an imperfect specimen, showing the arrangement of the plates in some of the rays, up to the third radials; also a few of the upper joints of the column connected with the base.

Fig. 5. Heterocrinus subcrassus, M. and W.......... ...........325

5 *a*. Side view of a specimen with the arms and a portion of the column attached. [Basal pieces not well represented.]

5 *b*. Side view of another specimen, with portions of the arms and column remaining.

5 *c*. View of another specimen showing (imperfectly) the large proboscis extending above the remaining portions of the arms, and connected with the arm-like range of anal pieces on its left.

Fig. 6a. Tentaculites Oswegoensis, M. and W ....................342

Showing two entire specimens, and fragments of others imbedded in the same mass of limestone.

Fig. 7. Tentaculites tenuistriatus, M. and W................ 341

7 *a* and *b*. Side views of different specimens.

Fig. 8. Tentaculites Sterlingensis, M. and W....................343

Showing two nearly entire specimens and fragments of others, in the same matrix.

Fig. 9. Megaptera Casei, M. and W........ ......... ...............337

9 *a*. Left side view of a specimen with portions of the posterior margin and wing broken away.

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Fig. 10. Dolabra? Sterlingensis, M. and W........... ...........339

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10 *c*. An anterior view of same.

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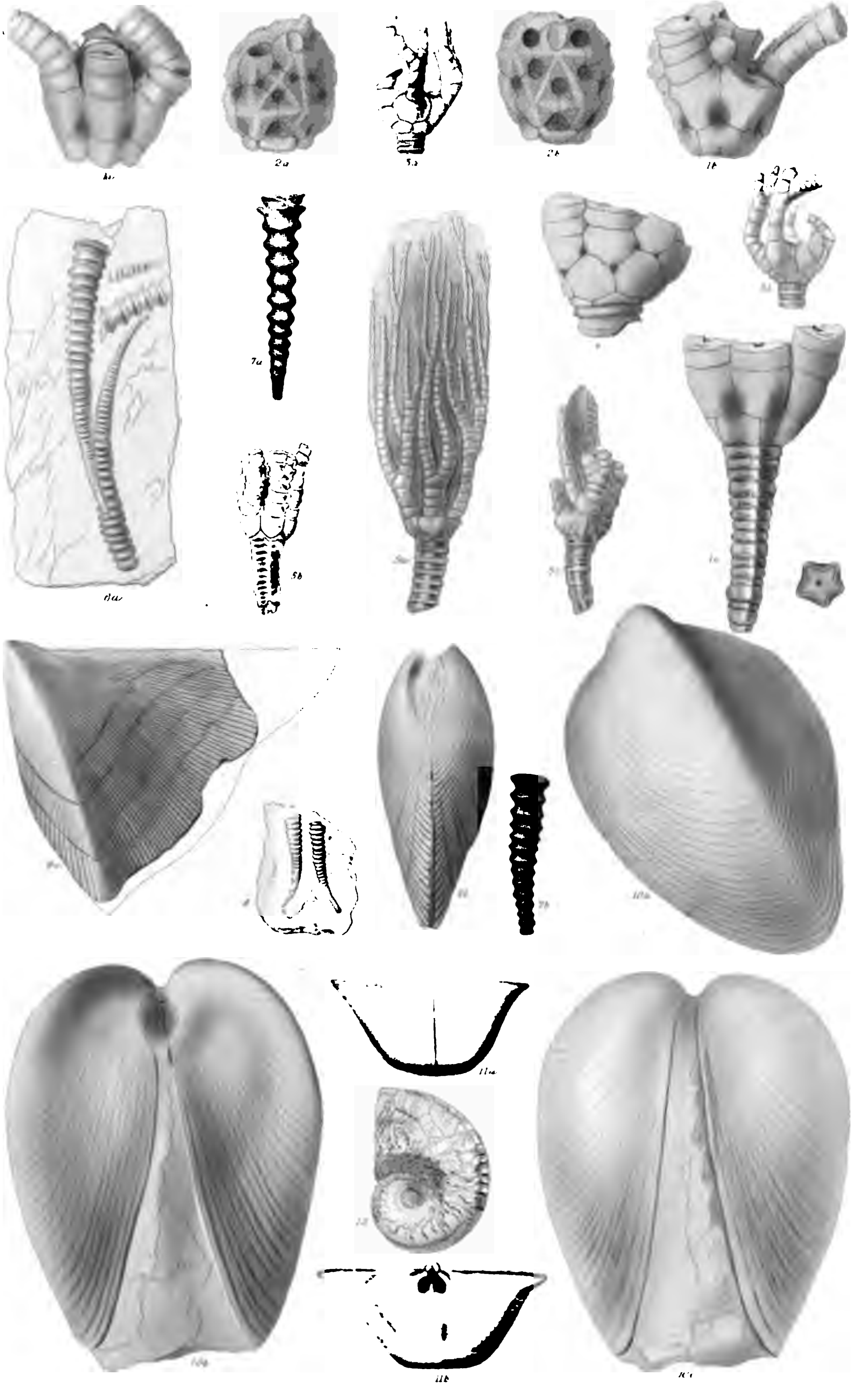
11 *a*. View of outside of ventral valve.

11 *b*. Interior of dorsal valve.

Fig. 12. Cyrtolites imbricatus, M. and W..... ............... ......340

# GEOLOGICAL SURVEY OF ILLINOIS

**LOWER SILURIAN** (Cincinnati Group) **MISCELLANEOUS**



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# PLATE V.

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Fig. 1. SACCOCRINUS CHRISTYI; Hall? (sp) .............................347

Side view of the internal cast of body and arm-bases; the form of the plates being defined by obscure raised lines along the positions of the sutures.

Fig. 2. PASCEOLUS? DACTYLIOIDES, Owen (sp.) .............................345

2 *a*. View of under side.
2 *b*. Side view of same.
2 *c*. Convex or upper side of same.

Fig. 3. ASTYLOSPONGIA?? CHRISTIANI, M. and W. .............................344

3 *a*. Side view.'
3 *b*, *c*. Opposite end views of same.

Fig. 4. PLEUROTOMARIA CYCLONEMOIDES, M. and W. .............................360

Side view of an imperfect internal cast. [Wants 2 or 3 more revolving lines on upper part of body whorl, and several smaller ones on the next above.]

Fig. 5. PLEUROTOMARIA CASII, M. and W. .............................359

Lateral view of an internal cast.

Fig. 6. SUBULITES (POLYPHEMOPSIS) BREVIS, M. and W. .............................362

Side view of a cast, with a part of the lip imbedded in the matrix. [The suture between the body whorl and the next one above, is too faintly defined.]

Fig. 7. OBOLUS [TRIMERELLA?] CONRADI, Hall .............................351

An internal cast.

Fig. 8. AMBONYCHIA ACUTIROSTRIS, Hall? .............................356

8 *a*. Left view of an internal cast. [Anterior basal margin too prominent, and beaks scarcely pointed enough.]
8 *b*. Right view of another cast. [Middle of anterior margin too prominent, and scars of posterior hinge teeth should range obliquely downward and backward.]
9 *c*. Anterior view of the specimen represented by fig. 8 *a*.

Fig. 9. AMPHICŒLIA NEGLECTA, McChesney .............................358

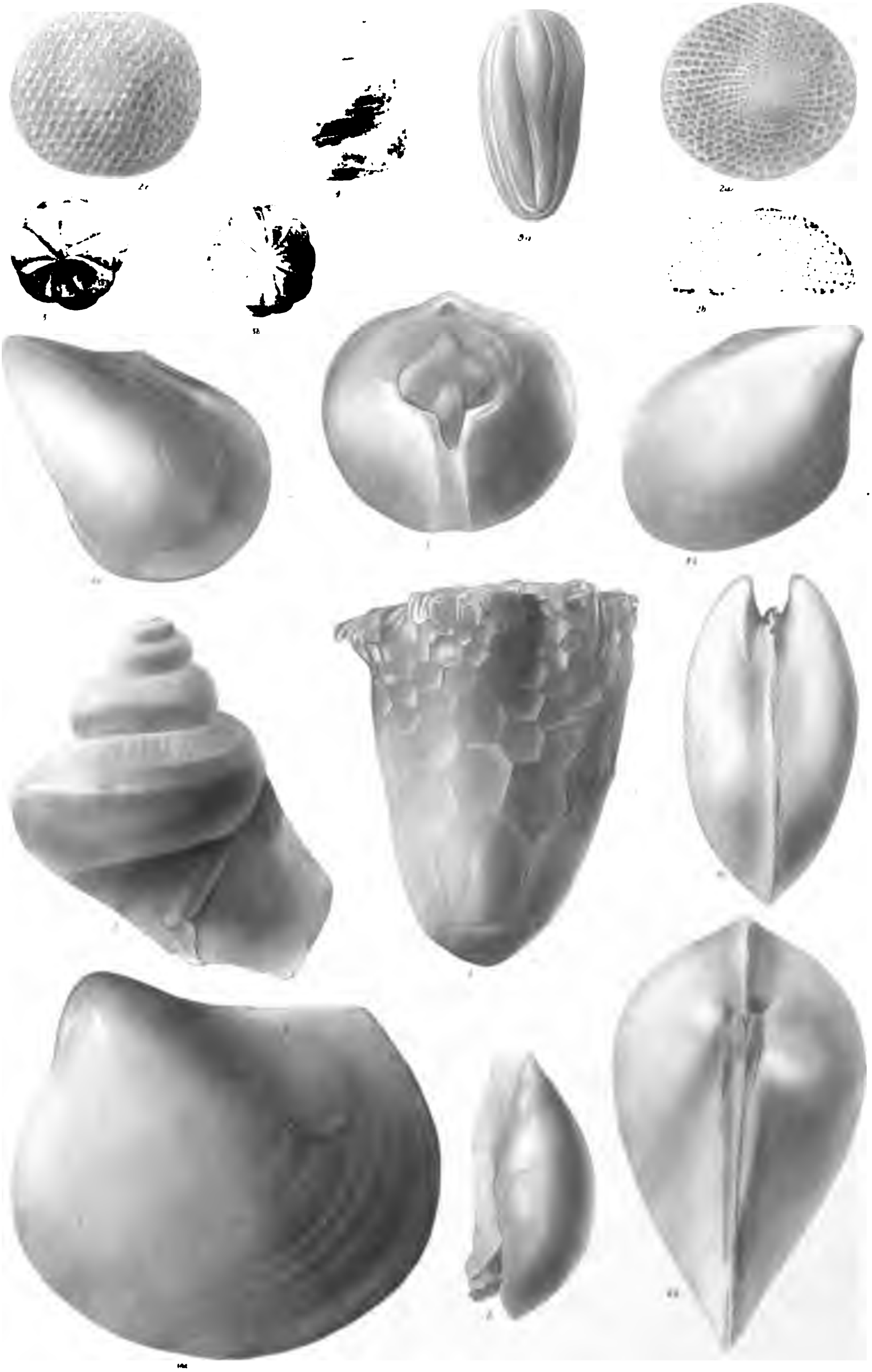
9 *a*. Left side view of an internal cast.
9 *b*. Cardinal view of same.

# GEOLOGICAL SURVEY OF ILLINOIS

UP. SILURIAN

(Niagara Group)

MISCELLANEOUS



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# PLATE VI.*

PAGE.

Fig. 1. DALMANITES DANÆ, M. and W................................363

1 *a.* An internal cast, showing more than half of a large individual.
1 *b.* The cephalic shield of a smaller specimen.
1 *c.* Profile side view of same.
1 *d.* Pygidium of a small specimen.
1 *e.* Profile view of same.
1 *f.* Hypostome found associated with the other specimens, and believed to be that of this species.

Fig. 2. CYCLONEMA ?

[The specimen of this species was mislaid before we had an opportunity to prepare a description.]

Fig. 3. PTERINEA THEBESENSIS, M. and W............................354

Cast of a left valve. [See cut of a better specimen in text.]

Fig. 4. MERISTELLA ? sp...... ............................................354

4 *a.* Dorsal view of a distorted specimen.
4 *b.* Ventral view of same
4 *c.* Profile view of do.

Fig. 5. CENTRONELLA BILLINGSIANA, M. and W.......................352

5 *a.* Dorsal view of a somewhat distorted specimen.
5 *b.* Ventral view of same.
5 *c.* Profile of same.
[See, also, cuts in text.]

Fig. 6. HEMIPRONITES SUBPLANUS, Conrad ? (sp). ..................349

6 *a.* Ventral valve. [Striæ too straight on posterior lateral margin.]
6 *b.* Dorsal valve, with portions of the shell about the beak removed

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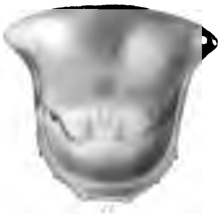
* The fossils figured on this plate came from a thin local band of limestone, supposed, at the time the plate was printed, to belong to the Lower Helderberg Group. Later investigations, however, have led us to believe it belongs more properly to the horizon of the Niagara Group.

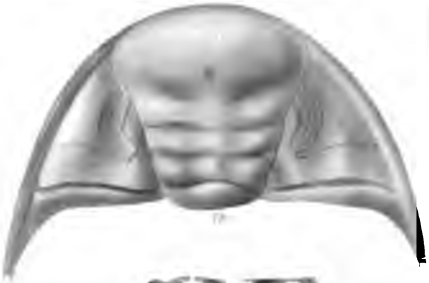
VOL. III

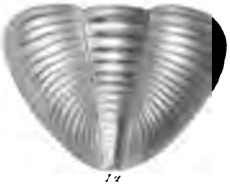
PL. 6

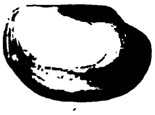
# GEOLOGICAL SURVEY OF ILLINOIS

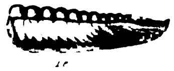
**UP. SILURIAN** (Lower Helderberg Group) **ARTICULATA & MOLLUSCA**

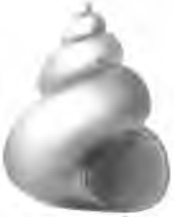


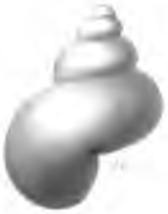


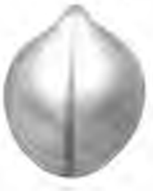


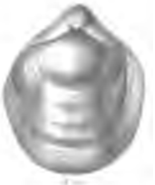


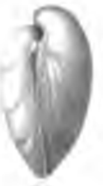


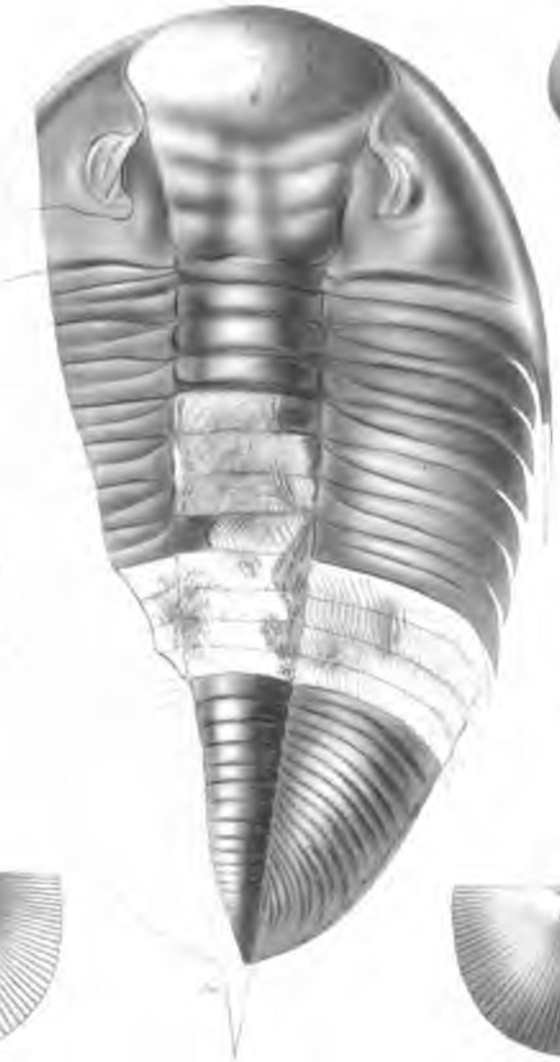


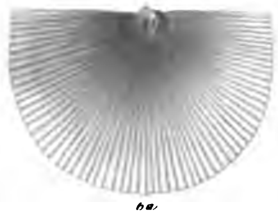












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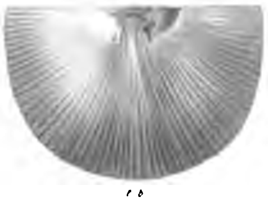

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## PLATE VII—*Continued.*

Fig. 10. STROPHOMENA (STROPHODONTA) CAVUMBONA, Hall...........374

10 *a*. A cast of the inside? of a dorsal valve, with some of the inner laminæ attached.

10 *b*. View of a partly exfoliated interior of a dorsal valve, as seen imbedded in the matrix.

Fig. 11. PLATYCERAS PYRAMIDATUM, Hall?.........................389

Side view of an imperfect specimen.

Fig. 12. PLATYCERAS SPIRALE, Hall...............................389

12 *a*. A specimen, with the apex and a portion of the lip broken away.

12 *b*. View of a nearly entire specimen.

12 *c*. View of another example with apex and lip broken away.

Fig. 13, 14. PLATYCERAS SUBUNDATUM, M. and W.......................387

13 *a*. View of the under side of a small specimen, as seen in the matrix

13 *b*. Upper view of another specimen, attached to the rock.

14 *a*. View of a large individual, with some of matrix concealing the spire, so as to make it appear free from the body whorl. On one side may be seen a few large folds, which, with the undulations of the striæ, indicate a sinuous outline of the lip.

14 *b*. Another view of the same, showing the spire to be nearly or quite in contact with the body of the shell.

Fig. 15.* ACIDASPIS HAMATA, Conrad...............................390

Showing a part of hooked appendage of the posterior side of the head.

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*By mistake numbered fig. 16 in the text.

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# GEOLOGICAL SURVEY OF ILLINOIS

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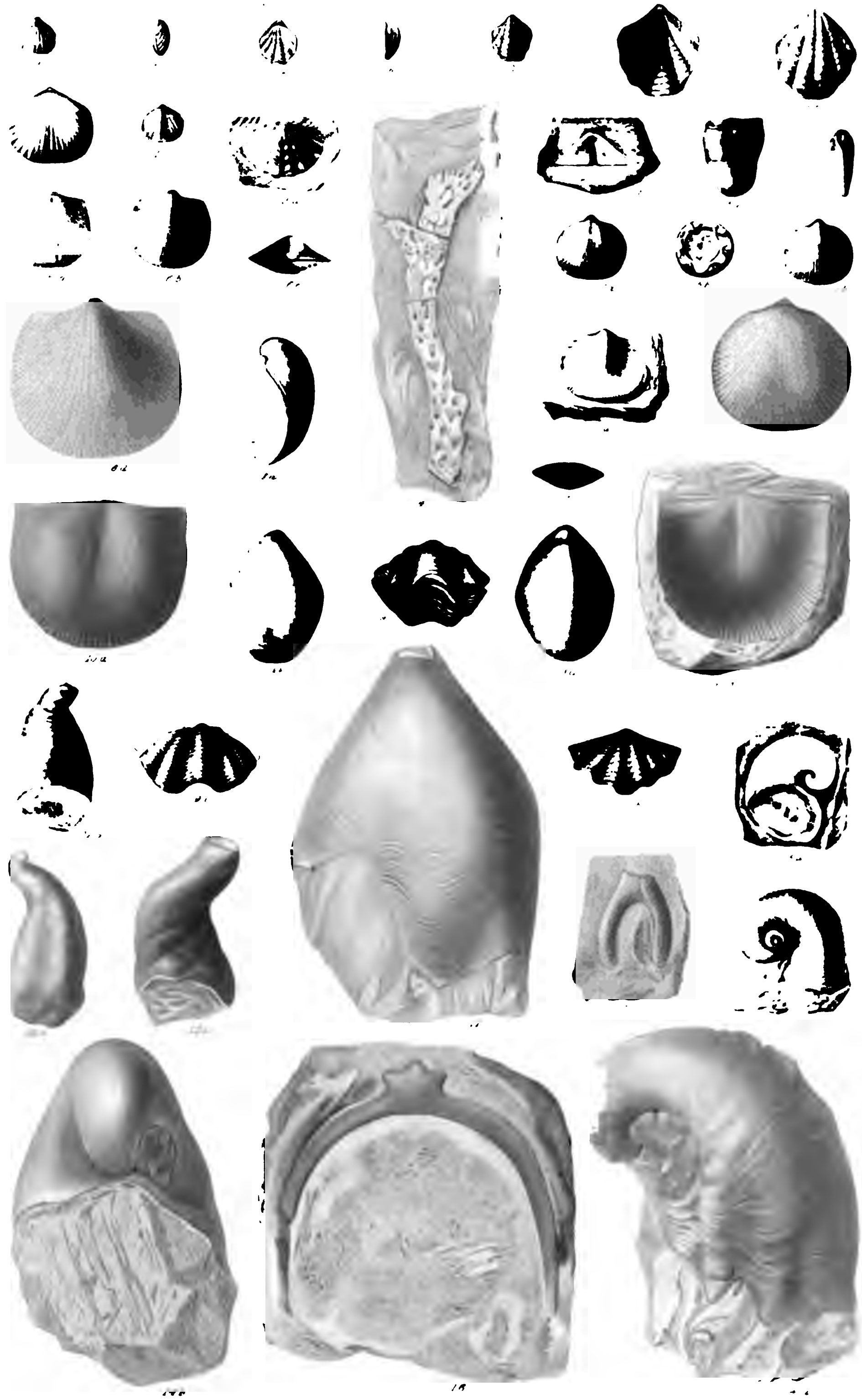

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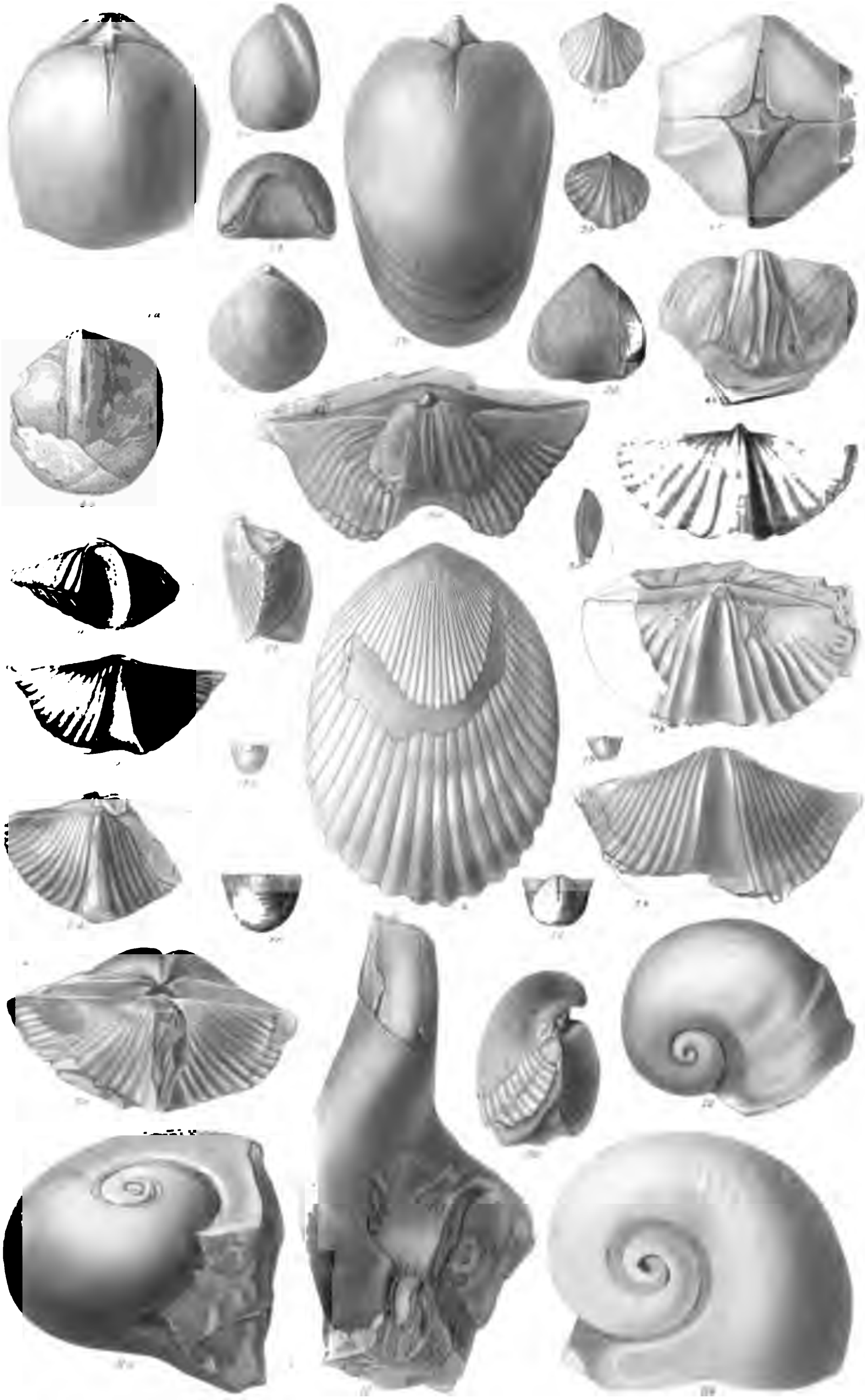
DEVONIAN Oriskany Formation MOLLUSCA



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*At the time this plate was printed, the sandstone from which the fossils illustrated on it were obtained, was supposed to belong more properly to the upper part of the Oriskany group; but later investigations have led to the conclusion that it belongs to about the horizon of the Onondaga division of the Corniferous group.

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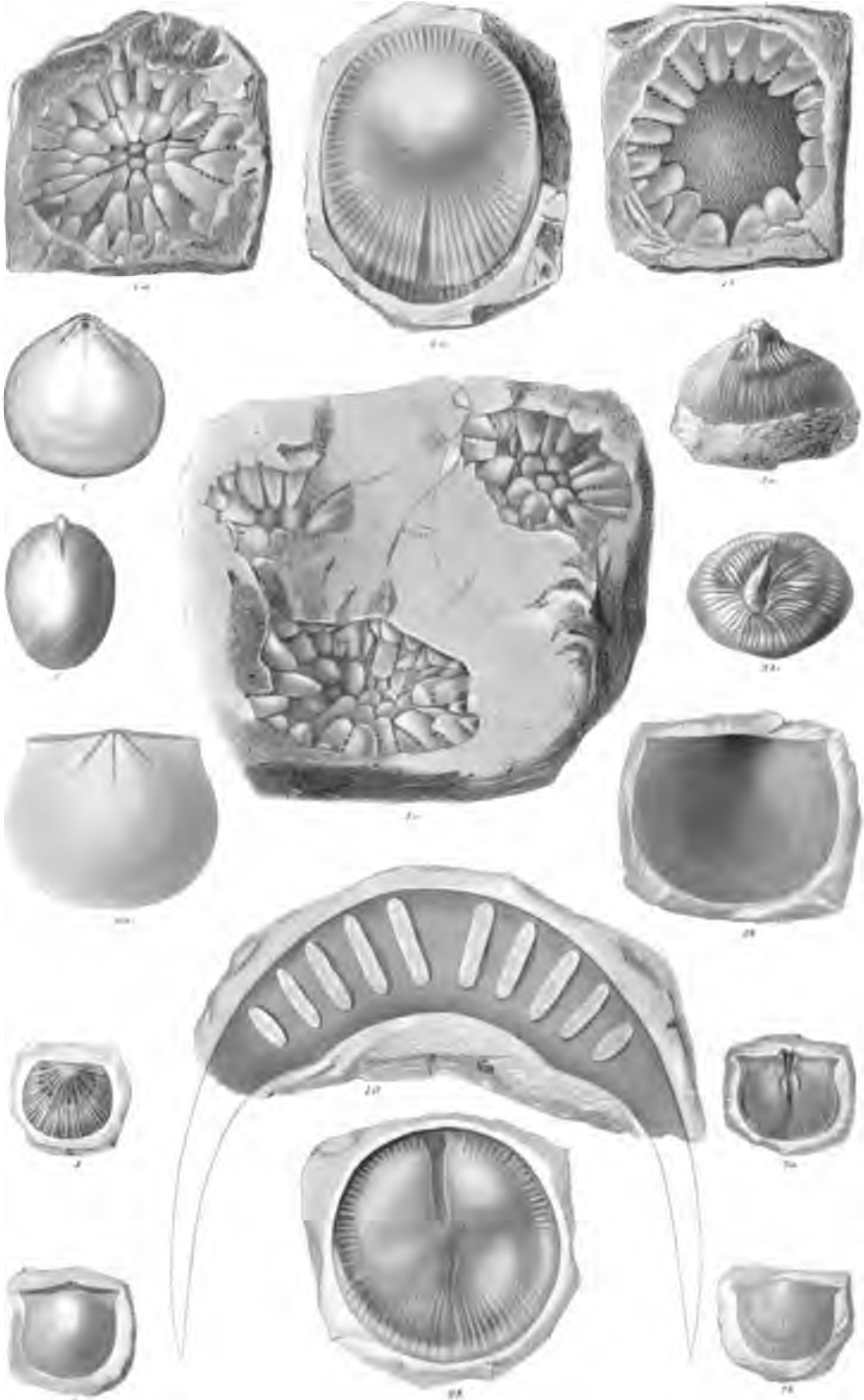

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# GEOLOGICAL SURVEY OF ILLINOIS

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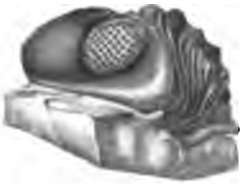
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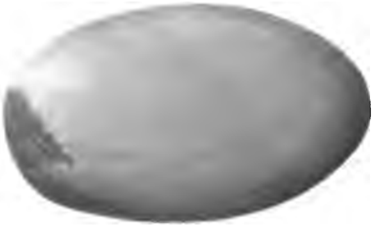

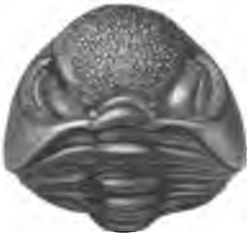

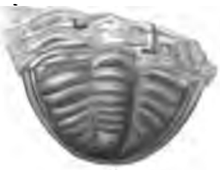

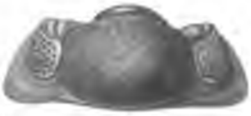

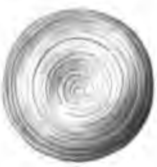

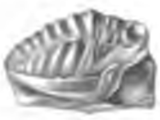

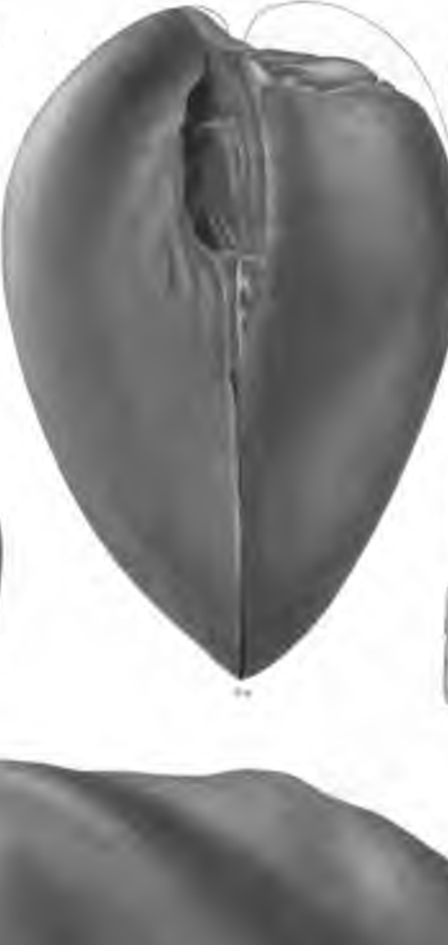

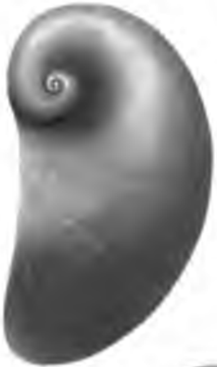

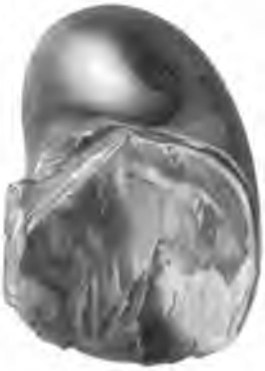

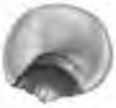

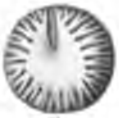

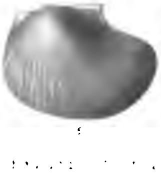

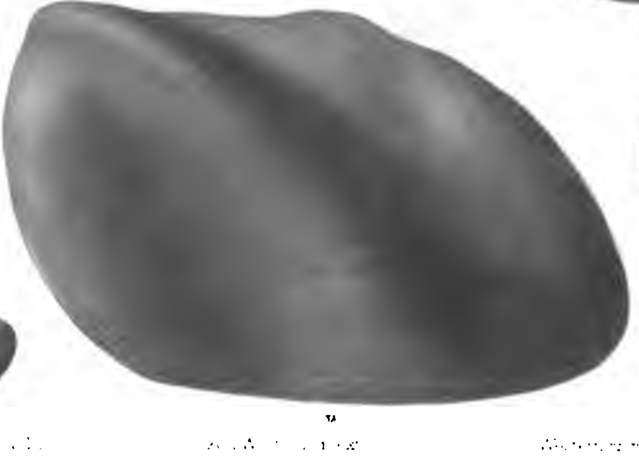

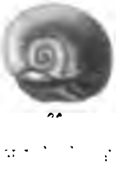

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| | 3 *b.* | Lateral view of same. | |
| | 3 *c.* | View of concave or nearly straight side of same. | |

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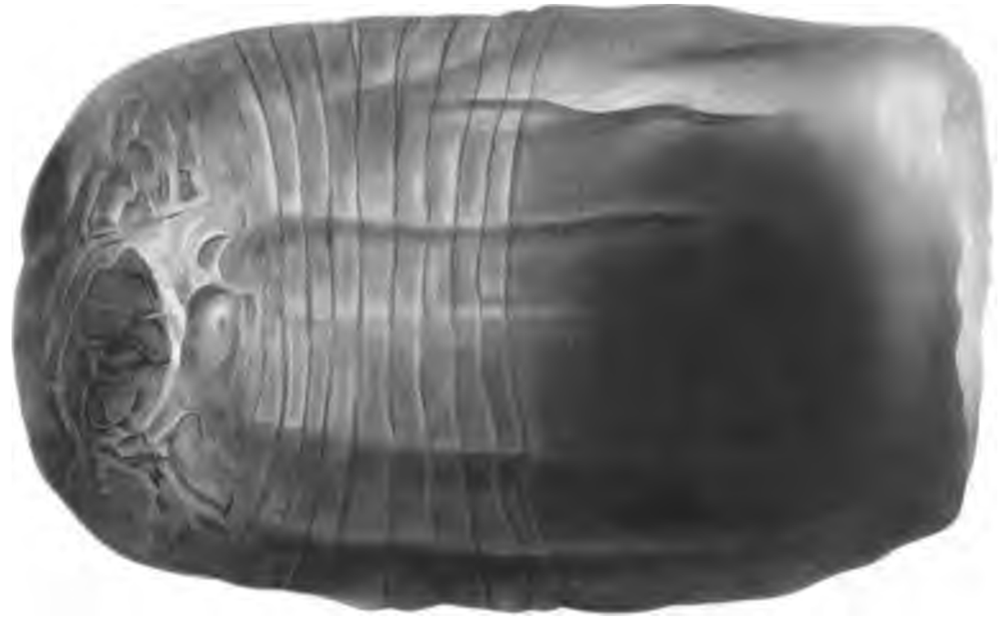

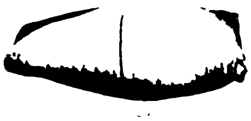

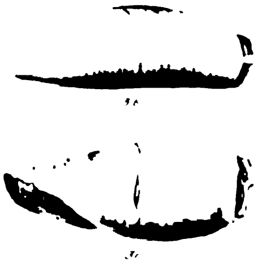

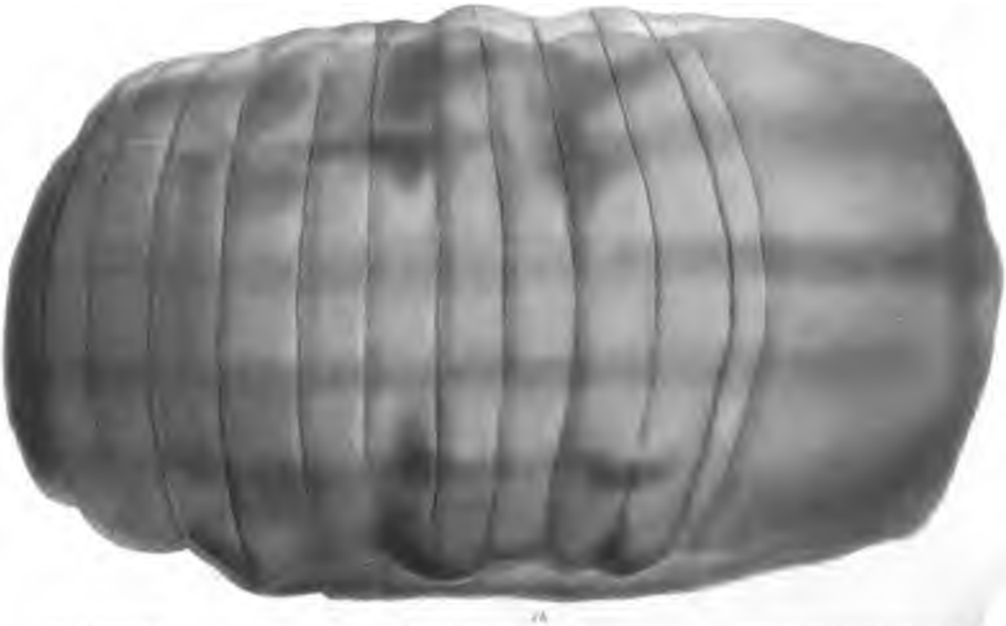

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# PLATE XIII.

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Fig. 1. LINGULA SUBSPATULATA, M. and W. .......................... 437

The specimen is flattened in shale, so as to fracture the shell a little along the middle, but the appearance of radiating lines there, is an error in the engraving.

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2 *a.* Front view.
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2 *c.* Dorsal view.

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Fig. 6. PENTAMERUS COMIS, Owen ? (sp.) .......................... 428

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6 *b.* Lateral view of same.
6 *c.* Dorsal view of same.

Fig. 7. ATRYPA ASPERA, Schloth (sp.) .......................... 430

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7 *b.* Lateral view of a smaller individual.
7 *c* and *d.* Dorsal and ventral views of same.

Fig. 8. SPIRIFER FORNACULA, Hall .......................... 433

8 *a.* Anterior view.
8 *b.* Lateral view of same.
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Fig. 9. ORTHIS IOWENSIS, var. FURNARIUS, Hall .......................... 424

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Fig. 10. ORTHIS MCFARLANEI, Meek .......................... 423

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10 *b.* Profile view of same.
10 *c.* Front view.
10 *d.* Dorsal view.

Fig. 11. ATRYPA RETICULARIS, Linn. (sp.) .......................... 432

A very large specimen, with the free margins of the valves greatly extended in the form of thin laminæ, the proper outline of the valves being indicated by the inner broken line.

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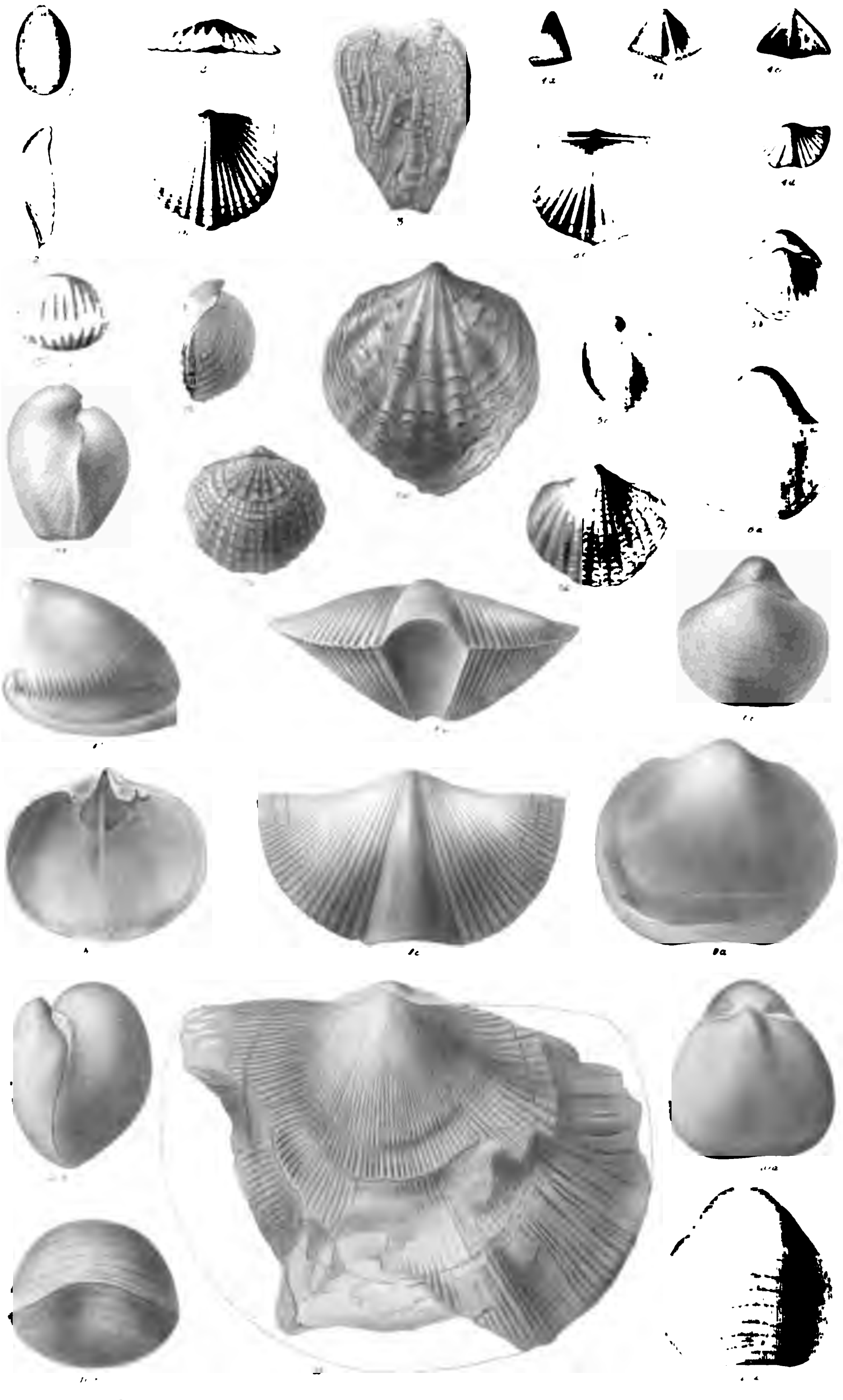

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Fig. 1. PORCELLIA NODOSA, Hall .................................458

1 *a.* Dorsal view of an internal cast.

1 *b.* Side view of same.

Fig. 2. GYROCERAS? ROCKFORDENSE, M. and W......................459

2 *a.* Side view of an internal cast, imperfect at both ends.

2 *b.* View of the outer side of the curve of same, showing the thin portion of the cast covering the nearly marginal siphuncle, to be broken through at places, so as to give the deceptive appearance of a small marginal lobe in the septa.

Fig. 3. PLATYCERAS HALIOTOIDES, M. and W.......................458

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3 *b.* An under view of the same, showing the form of the aperture.

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4 *b.* An upper view of same.

4 *c.* An upper view of another specimen in which the muscular scar is obsolete.

Fig. 5. PTERINEA? UNDULATA .....................................456

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Fig. 6. PERNOPECTEN SHUMARDIANUS, Winchell?....................453

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7 *b.* Dorsal view of same.

7 *c.* Side view of same.

7 *d.* Front view of same.

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View of a nearly perfect specimen, magnified about two diameters.

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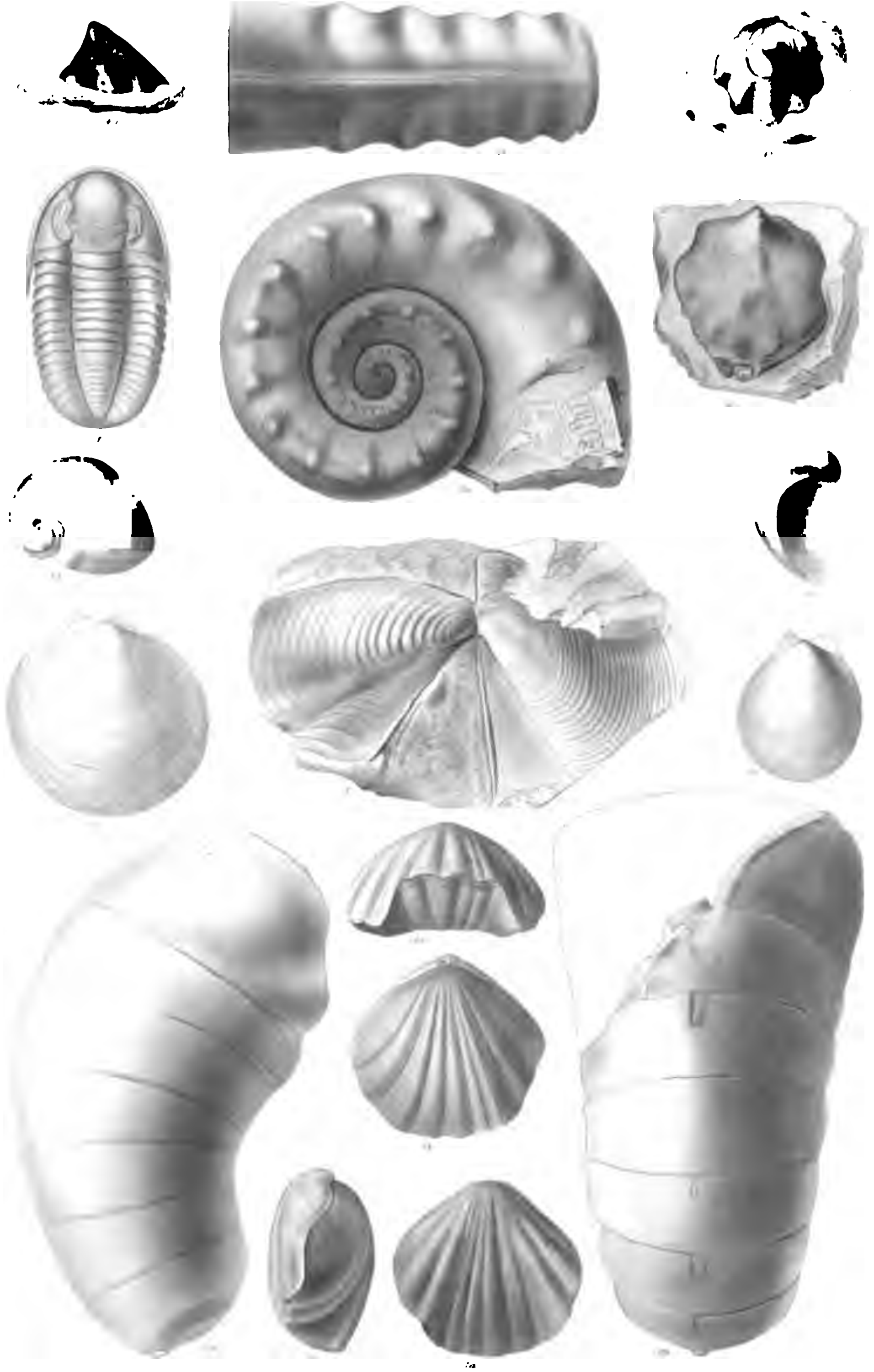
# GEOLOGICAL SURVEY OF ILLINOIS

SUB-CARBONIFEROUS

(Kinderhook Group)

ARTICULATA & MOLLUSCA



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# PLATE XV.

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Fig. 1. FENESTELLA (LYROPORA) RETRORSA, M. and W. ............ 504

A view of the thickened marginal support, with the thin reticulated expansion, occupied by the animal cells, all broken away.

Fig. 2. EVACTINOPORA GRANDIS, M. and W. ............ 503

A specimen, as seen broken across transversely, and imbedded in the matrix, showing the great length of the rays, the direction of the pores penetrating the same; and, near the middle, some indications of the laminated structure of the rays.

Fig. 3. PLATYCERAS BISERIALIS, Hall ............ 509

3 *a*. A lateral view, showing the curve of the beak, and the remaining portions of the spines on one side.

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# GEOLOGICAL SURVEY OF ILLINOIS

SUB-CARBONIFEROUS

MOLLUSCA

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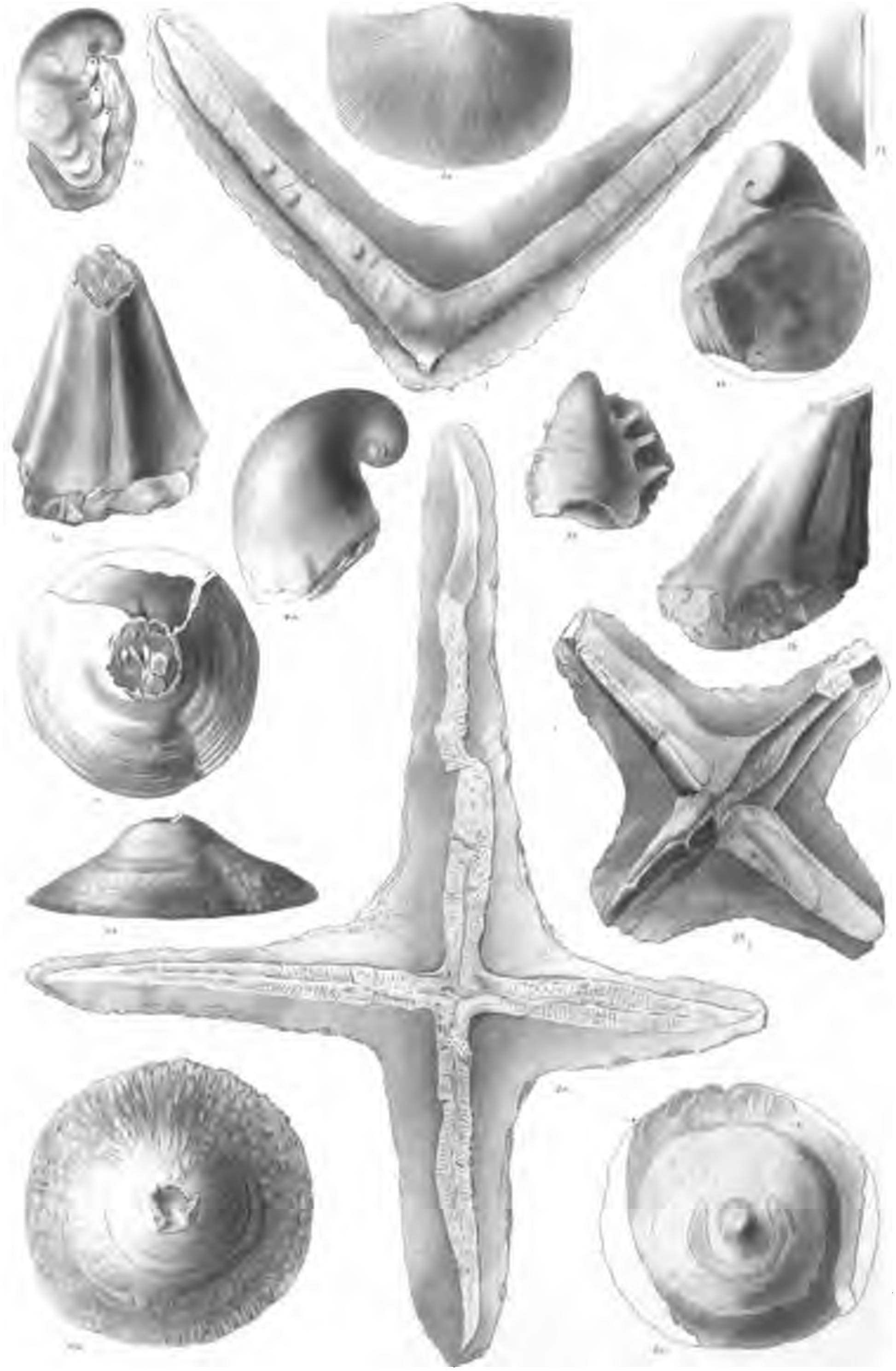

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# GEOLOGICAL SURVEY OF ILLINOIS

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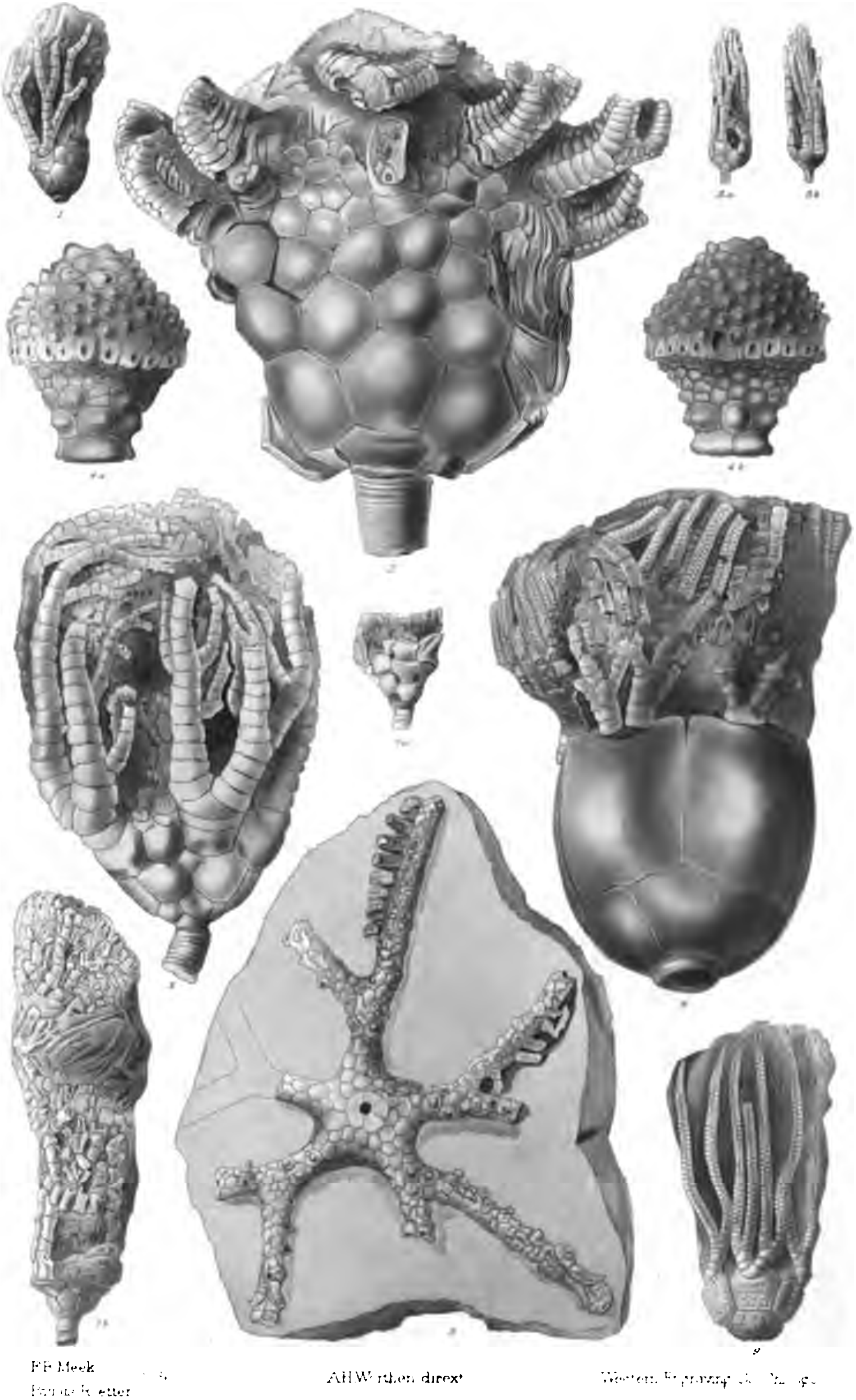
SUB-CARBONIFEROUS CRINOIDEA



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GEOLOGICAL SURVEY OF ILLINOIS

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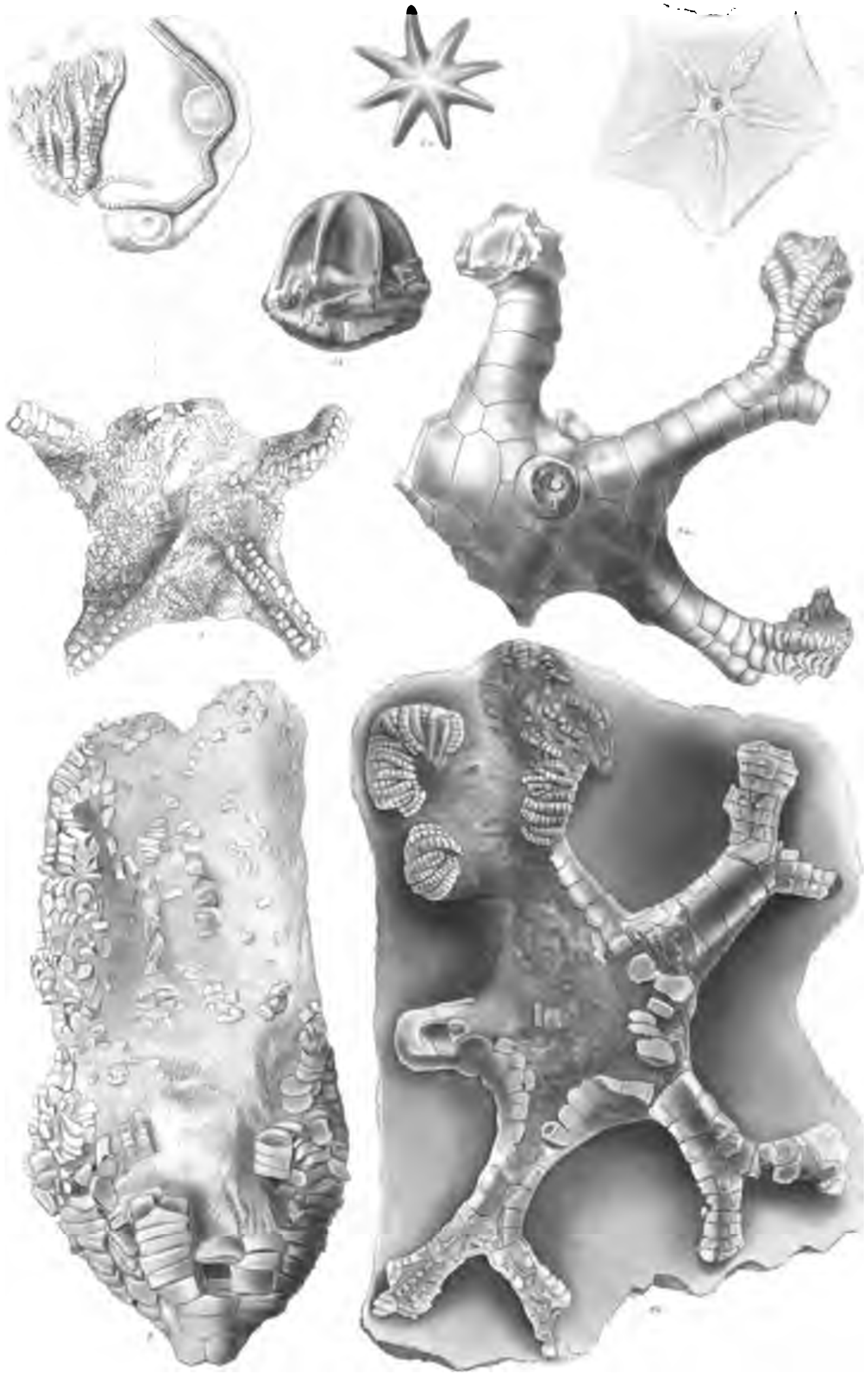

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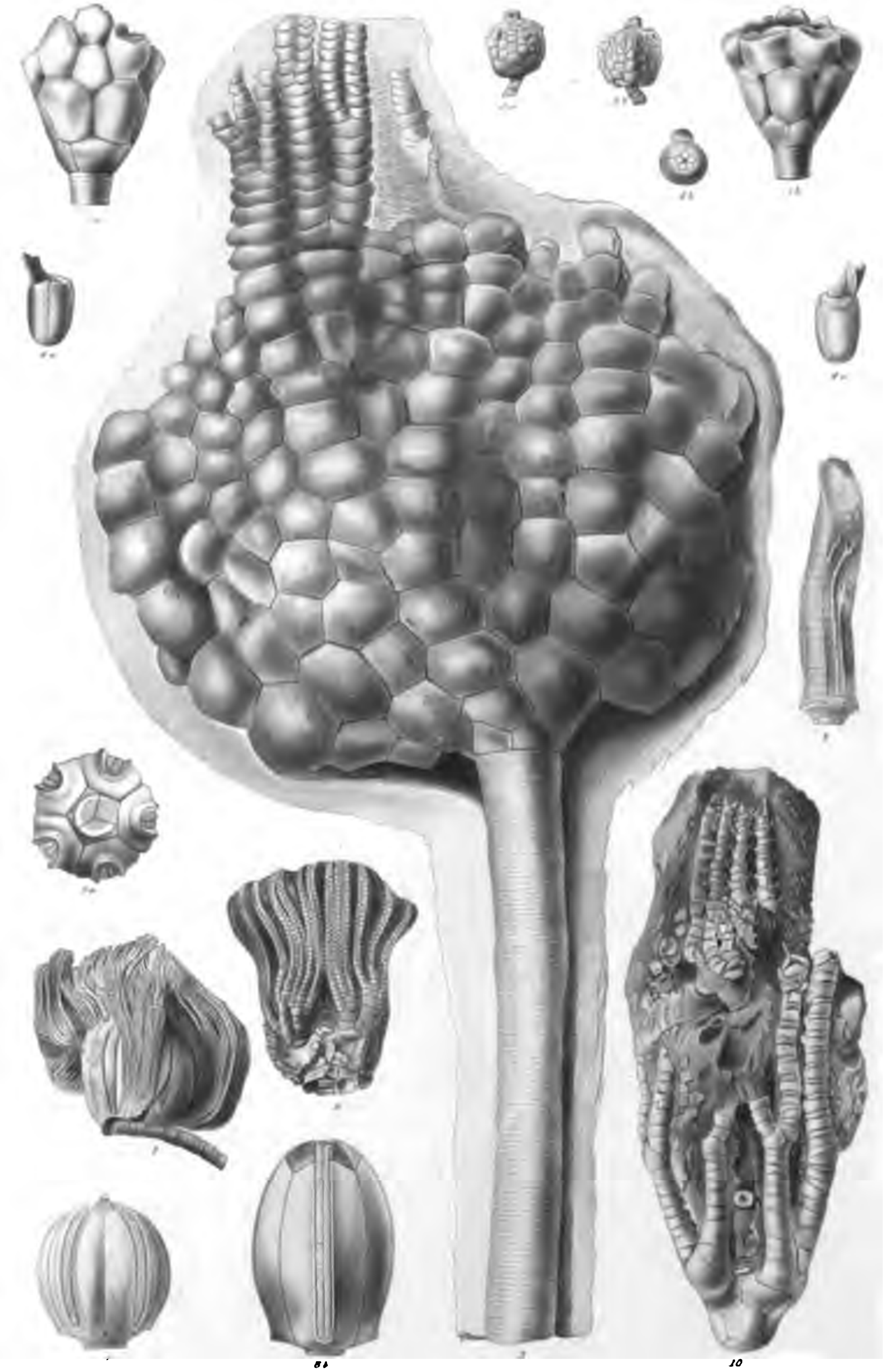
SUB CARBONIFEROUS ([illegible]) CRINOIDEA



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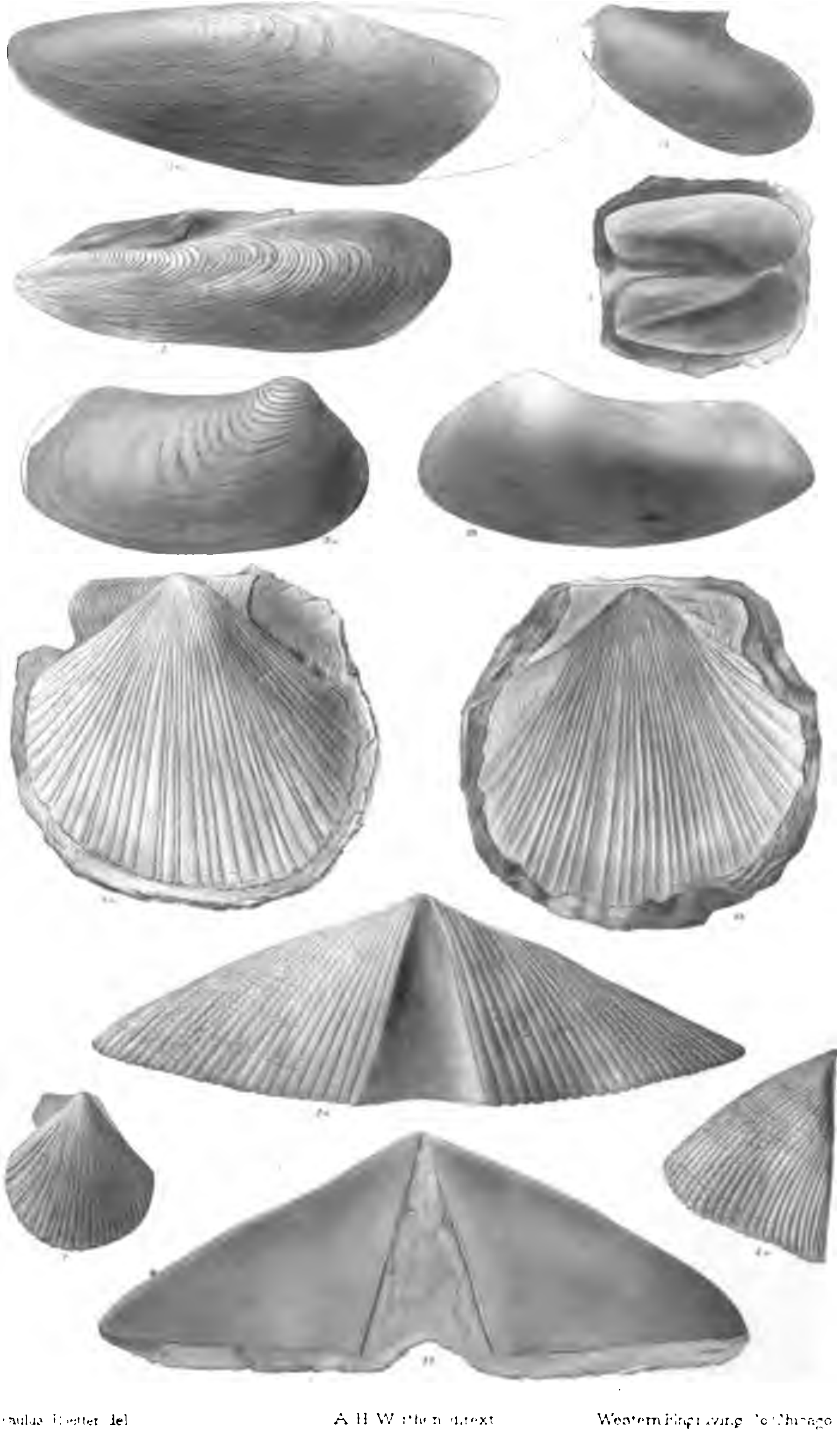
SUB-CARBONIFEROUS MOLLUSCA

(Waverly Group)



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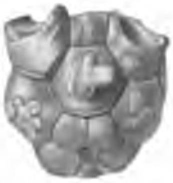
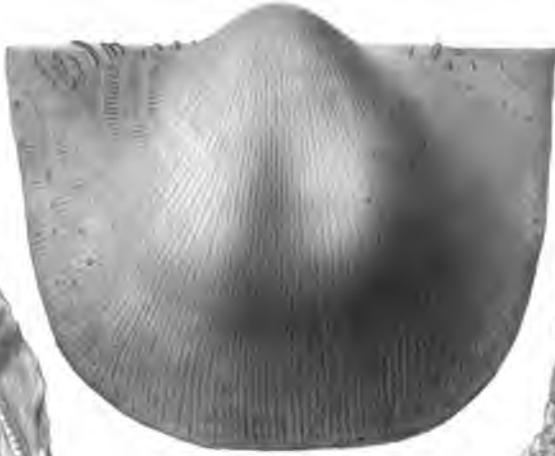
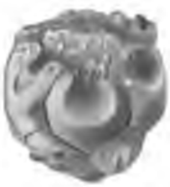
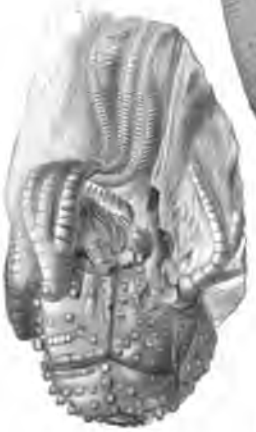
# GEOLOGICAL SURVEY OF ILLINOIS

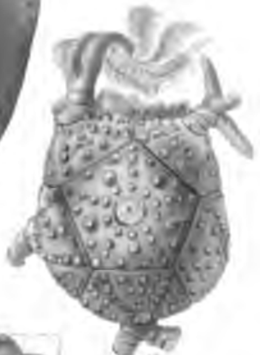
SUB CARBONIFEROUS ([illegible] Group) CRINOIDEA & MOLLUSCA

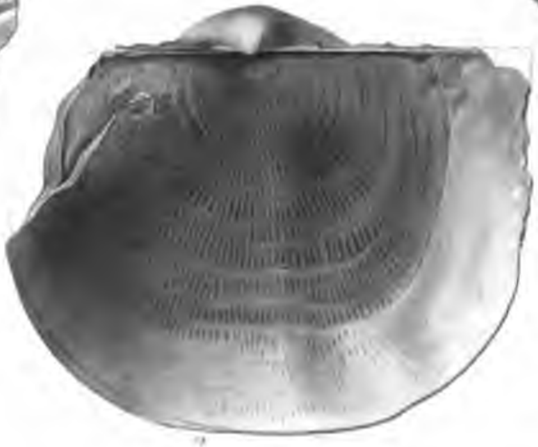


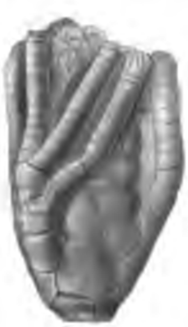


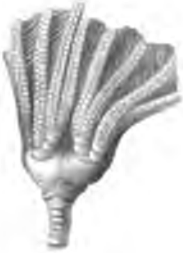


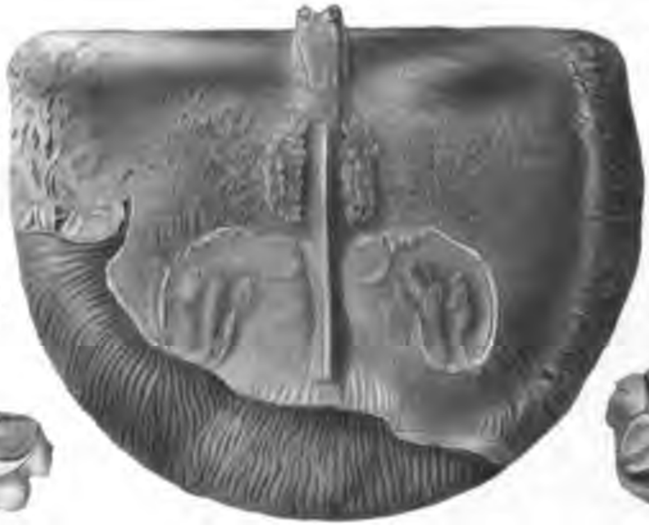


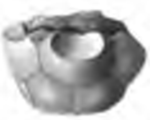


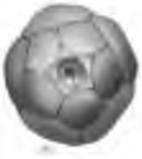


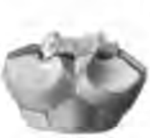


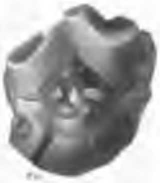


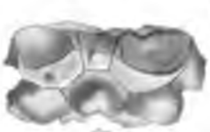


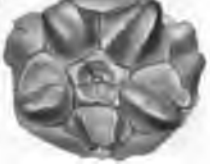












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